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VOLUME II, OPERATIONAL PROCEDURES, CSD-A-789-(2), MISSIONS 12 through 15

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VOLUME II — OPERATIONAL PROCEDURES

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PREFACE

This document is the first revised issue of Volume II of the AOH. This revision incorporates Crew Procedures Change Requests 1 through 53. Change requests released subsequent to the publication of this revision will be numbered sequentially with the next change number (i.e., 54 and on).

FOREWORD

This handbook, sections 4 and 5, of the Apollo Operations Handbook (AOH) series, is bound separately as Volume II and pertains only to the Extravehicular Mobility Unit (EMU). Volume I of the AOH contains sections 1, 2, and 3, and pertains to the description of the EMU.

The operational procedures are written specifically for Missions 12 through 15 EMU hardware and will be superseded by a mission oriented checklist which is reviewed by CSD for unique hardware procedures. Both the operational procedures and the malfunction procedures will be updated for the mission.

This handbook is composed of two major sections:

a. Section 4 provides a step-by-step operational procedure for activation and deactivation of EMU subsystems.

b. Section 5 provides emergency procedures for critical EMU symptoms and continuing diagnosis during EVA and post-EVA to determine the EMU malfunction.

Inquiries concerning this handbook should be addressed to Crew Systems Division, Apollo Support Branch, MSC, mail code EC9 or to Flight Crew Support Division, EVA Branch, Office Code CF25.

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ABBREVIATIONS

acfm	actual cubic feet per minute
AOH	Apollo Operations Handbook
CDR	Commander
cfm	cubic feet per minute
CM	command module
CMP	command module pilot
CSM	command/service module
CWG	constant wear garment
"DES" H_2O	descent water
ECG	electrocardiogram
ECS	environmental control system
EMU	extravehicular mobility unit
EV	extravehicular
LEVA	lunar extravehicular visor assembly
FCS	fecal containment system
ITMG	integrated thermal micrometeoroid garment
IV	intravehicular
IVA	intravehicular activity
kHz	kilohertz (thousand cycles per second)
LCG	liquid cooling garment
LiOH	lithium hydroxide
LM	lunar module
MSFN	Manned Space Flight Network
OPS	oxygen purge system
PGA	pressure garment assembly

PHA	pressure helmet assembly
PLSS	portable life support system
pos.	position
POS	primary oxygen system of PLSS
press.	pressure
psia	pounds per square inch absolute
psid	pounds per square inch differential
psig	pounds per square inch gage
RCU	remote control unit
SC	spacecraft
SSC	space suit communication
SW.	switch
TLSA	torso limb suit assembly
TM	telemetry
UCTA	urine collection and transfer assembly
UTS	urine transfer system
vlv	valve
WMS	waste management system
ZPN	impedance pneumograph
ΔT	change in temperature
ΔP	change in pressure

SECTION 4

OPERATIONAL PROCEDURES

This section describes the procedures for activation and deactivation of EMU equipment.

The order of appearance of groups of steps required to activate or deactivate components is not necessarily the order of performance of activation and deactivation of components.

STEP PROCEDURE	REMARKS
4.1 PGA DONNING AND DOFFING	Techniques in donning and doffing may vary within an individual step but the sequence of steps outline in each donning and doffing task shall be followed. "Normal" will be with assist from another crewman.
4.1.1 PGA IV CONFIGURATION DONNING PROCEDURES	CMP only.
1 Donning FCS	
a. Don FCS as conventional underwear and place genitals through front opening.	
b. Position FCS around waist and thighs to insure a seal. Insure a snug fit with no sag in the crotch portion of the FCS.	
2 Donning CWG	
a. Open front buttons.	
b. Don CWG as conventional long underwear.	
c. Adjust feet into socks.	

STEP	PROCEDURE	REMARKS
d.	Insert bioinstrumentation leads through slots on chest area of CWG.	Step 4.1.1-3 must be performed before Steps 4.1.1-2d and e. When transferring bioinstrumentation between CWG or LCG, or when reinstalling after removal, the signal conditioners should not be removed from the pockets in the biobelt. Only the nine-pin airlock connector, the sternal electrode harness (Blue Code), and the axillary harness (Yellow Code) should be disconnected. The color code of the harness to signal conditioner should be observed when reinstalling the biobelt. The electrodes are not removed from skin to change garments.
e.	Button front opening.	

STEP	PROCEDURE	REMARKS
3	Donning bioinstrumentation system (prelaunch)	
a.	Shave electrode sites where necessary. Shower after shaving.	
b.	During PGA suiting procedure prior to launch, clean electrode sites with alcohol and let dry. Attach electrodes under medical direction.	CWG is donned to waist.
c.	Assemble signal conditioners, biomedical harness with biomedical belt, and test as a system.	Use caution in mating biomedical connector to signal conditioners. Connectors are keyed for proper fit.
d.	Don top half of CWG, insert harness connectors (blue and yellow) through holes in CWG. Snap biomedical belt to CWG.	See remarks page 4-3, Step 4.1.1-2d.
e.	Connect electrode harness to proper color-coded signal conditioner. Dot on electrode harness is facing out.	
f.	Perform functional check.	
g.	Adjust ECG gain for normal signal to 40 percent of full scale.	
h.	Adjust ZPN gain to allow maximum inhalation to be at or near full scale.	

STEP	PROCEDURE	REMARKS
i.	Don lower half of PGA (Step 4.1-5) and connect nine-pin biomedical connector.	See remarks page 4-3, Step 4.1.1-2d.
j.	Perform functional check prior to donning PGA helmet and gloves.	
4	Donning UCTA	
a.	Obtain proper size cuff and roll down to cuff flange after removing flange from UCTA.	
b.	Place penis in flange and roll cuff on.	If the UCTA has been worn, it will be stowed in the PGA with a UCTA clamp on the cuff. Remove and stow the UCTA clamp.
c.	Attach cuff half of the UCTA flange to the UCTA by depressing the flange release lever and twisting the two halves together.	
d.	Aline the colored waistband patches to the corresponding colors on the UCTA.	Place waistband of harness across "small of the back."
e.	Attach the crotch strap to the UCTA.	Strap length can be adjusted at mating point. Verify all straps attached.
f.	Connect hand pump to drain hose and evacuate all gas from the UCTA through the drain hose.	This step is required for donning at 14.7 psia ambient pressure only — not required for 5 psia donning.
g.	Don leg part of the PGA.	

STEP	PROCEDURE	REMARKS
h.	Connect the UCTA drain hose to the UCTA transfer hose assembly on the suit.	Do not coil or loop the drain hose. Do not put hose near the PGA biomedical injection patch.
i.	Finish donning PGA.	
5	Donning PGA	
a.	Remove protective cover from PGA electrical connector and two protective plugs from gas connectors and stow.	
b.	Loosen torso tiedown strap.	Remove donning lanyards from UCTA/biomedical injection access flap.
c.	Fully open both the restraint and pressure-sealing zippers.	If unassisted, insert the red suit-donning lanyard through the pull tab of restraint zipper slider and the blue suit-donning lanyard through the pull tab of pressure-sealing zipper slider.
d.	Grasp PGA at sides. Do NOT pick up PGA at pressure-sealing zipper location. Place both feet into PGA and work feet into the boots.	
e.	Pull excess liner material up around leg. Grab PGA at knee convolutes and pull boots onto feet.	Point toes toward boots to avoid pickup of excess liner material.
	CAUTION Do not sit on zippers.	
f.	Pull PGA to knee position.	

STEP	PROCEDURE	REMARKS
g.	With front of PGA hanging forward, go to squatting position placing PGA front in lap.	
h.	Reach inside of right leg and connect UCTA quick-disconnect to PGA-UCTA hose assembly.	
i.	Aline index marks and connect biomedical harness electrical branch to suit electrical harness.	
j.	Verify communications carrier connection from electrical harness is pushed through neckring.	
k.	Insert one arm completely into PGA arm while simultaneously inserting head into neckring with assistance from free arm. Insert free arm into other PGA arm.	Alternate methods such as full insertion of arms into suit sleeves, then insertion of head through neckring, or insertion of one arm, then the combined insertion of second arm and head are acceptable, provided the load on the PGA, and/or the zippers in not increased.
l.	Stand erect to permit PGA to settle over torso and limbs.	
m.	Close restraint and pressure-sealing zipper closures.	If unassisted, grasp back of neckring and top of CWG with one hand. With other hand, grasp red donning lanyard, pull out and down to position restraint zipper slider toward middle of the back. Pull red donning lanyard over buttocks while running fingers ahead of slider to prevent snagging of CWG.

STEP	PROCEDURE	REMARKS
		Grasp cloth tab of restraint slider and fully close. Remove suit-donning lanyard, tuck slider tab up into PGA, and stow lanyard in pocket. Grasp back of neckring with one hand and with other hand grasp blue donning lanyard; pull lanyard out and down to fully close pressure-sealing zipper. Remove and stow blue suit donning lanyard.
n.	Engage snap fastener of slider tab to receptacle on PGA. Position lock assembly over slider and push lock button to LOCK. Close cover flap over zipper and engage snap fasteners.	
o.	Don communication carrier by spreading the ear cups and then make fine adjustments to the mike boom by bending it from the center. Adjust the chinstrap for proper fit.	Do not bend mike boom more than 80° from center. Bend mike boom from the middle section only. Do not straighten or bend the mike boom unless necessary.
p.	Connect electrical lead to upper branch of electrical harness.	

STEP	PROCEDURE	REMARKS
	q. Connect gas umbilical to PGA.	
	r. Provide ventilation flow.	
6	Donning pressure helmet	Steps 4.1.1-6 and -7 can be reversed provided the second step is accomplished with decreased gas flow.
	a. Place helmet-attaching ring lock subassembly in ENGAGE.	
	b. Place pressure helmet on helmet-attaching ring, insure proper alinement by alining dual white lines and press down on helmet.	
	c. Position lock subassembly to LOCK.	
	CAUTION PGA neckring alinement marks must be alined with the helmet "locked" alinement marks to insure proper helmet ventilation.	
7	Donning PGA gloves	
	a. Gloves or helmet may be difficult to don. If so, stop gas flow momentarily.	
	b. Place suit wrist disconnects in ENGAGE.	
	c. Insure that glove palm restraint is loosened, then place hand into glove.	

STEP	PROCEDURE	REMARKS
d.	Aline glove wrist disconnect with suit wrist disconnect and engage both units.	
e.	Insure that glove can be easily rotated and place the wrist disconnect to LOCK.	
f.	Adjust glove palm restraint.	
g.	Don other glove in the same way.	
8	Donning Neckdam	The neckdam is donned before water egress to prevent water from entering the open neck area of the TLSA.
1	Place helmet-attaching ring lock assembly in ENGAGE position.	
2	Slip neckdam over head so that eyelet tab is forward.	
3	Aline neckdam ring eyelet tab with index marks on helmet-attaching ring and snap tab in place.	
4	Continue pushing other tabs down into place until all tabs of neckdam are latched.	
5	Place the lock assembly into LOCK.	

STEP	PROCEDURE	REMARKS
4.1.2	PGA IV CONFIGURATION DOFFING PROCEDURE	
1	Doffing PGA gloves	
a.	Decrease suit pressure to less than 0.75 psig.	
b.	Loosen palm restraint.	
c.	Place wrist disconnect in open position and remove glove.	
d.	Doff other glove.	
2	Doffing pressure helmet	
a.	Place helmet attaching ring latching mechanism to the open position.	
b.	Lift the helmet up and out of helmet attaching ring.	
3	Doffing PGA	
a.	Empty UCTA. (See AOH-LM and - CSM procedures.)	
b.	Open slide zipper cover flap.	Unlock pressure sealing zipper lock and release slider tab snap fastener.

STEP	PROCEDURE	REMARKS
c.	Fully open pressure and sealing zippers. CAUTION Do not sit on zippers.	If unassisted, remove blue donning lanyard from lanyard pocket and insert into pressure sealing zipper tab. Grasp blue suit-donning lanyard and pull until the pressure-sealing zipper tab is full OPEN and remove suit-donning lanyard. Remove red suit-donning lanyard from lanyard pocket; release restraint zipper tab from stowed position; and insert lanyard in zipper tab. Grasp red suit-donning lanyard; pull until restraint zipper is full OPEN; and remove lanyard. Restow red and blue lanyards.
d.	Disconnect gas inlet and outlet hoses.	
e.	Disconnect communications carrier electrical lead and undo chinstrap to remove communication carrier. Remove communications carrier carefully. Do NOT bend mike boom.	
f.	Grasp PGA at rear-entry area and separate slide fasteners; then slip PGA from around back and buttocks.	
g.	Grasp helmet-attaching ring, slip head out, and pull both arms away from PGA.	
h.	Disconnect biomedical connector.	
i.	Disconnect UCTA drain hose quick-disconnect. (See Step 4.1.2-4.)	

STEP	PROCEDURE	REMARKS
j.	Remove legs from TLSA.	
k.	Replace protective covers and caps on PGA electrical connector and two gas connectors.	

STEP	PROCEDURE	REMARKS
4	Doffing UCTA	
	a. Drain UCTA before doffing. (See AOH-LM and -CSM procedures.)	
	b. Partially doff PGA to disconnect the UCTA drain hose disconnect.	
	c. Disconnect UCTA drain hose from suit-mounted UCTA transfer hose assembly.	
	d. Complete doffing of PGA.	
	e. Remove UCTA elastic harness by detaching waistband Velcro patches while holding UCTA in place.	
	f. Remove cuff half of UCTA flange by using release button and twisting motion.	
	g. Roll cuff from penis.	
	h. Fold cuff and use UCTA clamp to close.	
	i. Stow UCTA in PGA.	
5	Doffing biomedical harness and belt	See page 4-3, Step 4.1.1-2d.
	a. Disconnect electrical leads of biomedical electrode harness from signal conditioners in biomedical belt.	See Step 4.8.2-3 for permanent removal procedures, if necessary.
	b. Disengage snaps securing biomedical belt.	

STEP	PROCEDURE	REMARKS
6	Doffing CWG (if applicable)	The CWG without the FCS is normally worn throughout the flight. See remarks page 4-3, Step 4.1.1-2d.
	a. Unbutton front opening.	
	b. Pass bioinstrumentation electrode harness leads through slot on chest area of CWG.	
	c. Remove CWG in the same manner as conventional long underwear.	
7	Doffing FCS	
	Doff FCS in the same manner as conventional underwear shorts.	
8	Doffing neckdam	The neckdam is used only for water egress.
	a. Unlock helmet-attaching ring and separate neckdam.	
	b. Pull neckdam over head.	

STEP	PROCEDURE	REMARKS
4.1.3	PGA EV CONFIGURATION DONNING PROCEDURE	
1	Donning FCS (see Step 4.1.1-1)	
2	Donning LCG CAUTION Take care to avoid damaging LCG H_2O lines.	The LCG replaces the CWG for EVA. The LCG may be worn during periods of IVA.
	a. Unstow LCG from bag.	
	b. Open front entry fastener of LCG.	
	c. Don the LCG like conventional long underwear and adjust feet into socks.	
	d. Insert bioinstrumentation leads through holes on front of LCG.	See remarks page 4-3, Step 4.1.1-2d.
	e. Close front entry of LCG.	
3	Donning bioinstrumentation systems (see Step 4.1.1-5)	Verify that LCG manifold is outside of biobelt.
4	Donning UCTA (see Step 4.1.1-4)	
5	Donning PGA	
	a. Remove one PGA electrical connector cover and four PGA gas connector caps.	

STEP	PROCEDURE	REMARKS
b.	Loosen torso tiedown strap.	
c.	Fully open the restraint, pressure sealing, and ITMG zippers.	If alternate method of donning is to be used, unstow donning lanyards and attach after opening zippers. Insert red suit-donning lanyard through pull tab of restraint zipper slider and blue suit-donning lanyard through pull tab of pressure-sealing zipper slider.
d.	Grasp PGA at sides. CAUTION Do NOT pick up PGA at pressure-sealing zipper location.	
	Place both feet into PGA and work feet into the boots. Pull excess liner material up around legs.	Point toes toward boots to avoid pickup of excess liner material.
	Grab PGA at knee convolutes and pull boots onto feet. CAUTION Do not sit on zippers.	
	Pull PGA tight to knee position. Stand up. Grasp side of coverlayer and pull to waist position with zipper below buttocks.	

STEP	PROCEDURE	REMARKS
e.	With front of PGA hanging forward, go to squatting position putting PGA front in lap.	
f.	Connect the UCTA quick-disconnect to PGA-UCTA hose assembly.	
g.	Aline index marks and connect biomedical harness electrical branch to suit electrical harness.	
h.	Remove water connector plug and connect LCG water connector to PGA multiple water connector receptacle.	If LCG is not used, do not remove water connector plug.
i.	Verify communications carrier connection from electrical harness is pushed through neckring.	
j.	Insert one arm completely into PGA arm while simultaneously inserting head into neckring with assistance from free arm. Insert free arm into other PGA arm.	Alternate methods such as full insertion of arms into suit sleeves, then insertion of head through neckring; or insertion of one arm, then the combined insertion of second arm and head is acceptable provided the load on the PGA, and/or the zippers is not increased.

STEP	PROCEDURE	REMARKS
k.	Stand erect and settle PGA over torso and limbs.	If unassisted, grasp back of neckring and top of CWG with one hand. With other hand, grasp red donning lanyard, pull out and down to position restraint zipper slider toward middle of the back. Pull red donning lanyard over buttocks while running fingers ahead of slider to prevent snagging of CWG. Repeat with blue lanyard and sealing zipper.
l.	Close restraint and pressure-sealing zipper closures.	
m.	Engage snap fastener of slider tab to receptacle on PGA. Position lock assembly over slider and push lock button to LOCK. Close cover flap over zipper and engage fasteners.	

4.1 PGA DONNING AND DOFFING

STEP	PROCEDURE	REMARKS
n.	Don communication carrier by spreading the ear cups and then make fine adjustments to the mike boom by bending the boom from the center. Adjust the chinstrap for proper fit.	Do not bend mike boom more than 80° from center. Bend mike boom from the middle section only. Do not straighten of bend unless necessary.
o.	Connect communications carrier electrical lead to upper branch of electrical harness.	
p.	Connect gas umbilical to PGA.	
q.	Provide ventilation flow.	
6	Donning lunar boots.	
a.	Insert PGA boots into lunar boots and position with attached donning straps.	
b.	Engage snap fasteners on tongue of boot.	
c.	Latch adjustment strap and buckle.	
7	Donning PLSS/OPS (Step 4.3.1)	

STEP	PROCEDURE	REMARKS
8	Donning pressure helmet	
	a. Apply antifog solution.	See Step 4.8.1-2a.
	b. Helmet may be difficult to don. Is so, stop gas flow momentarily. CAUTION Prior to donning helmet, PGA diverter valves must be EV (vertical) position if O_2 flow is to be provided by PLSS/OPS.	
	c. Place helmet-attaching ring lock subassembly in ENGAGE.	
	d. Place pressure helmet on helmet-attaching ring; insure proper alinement by alining dual white lines and press down on helmet.	
	e. Position lock subassembly to LOCK. CAUTION PGA neckring alinement marks must be alined with the helmet "locked" alinement marks to insure proper helmet ventilation.	
9	Donning EV gloves	
	a. Don comfort gloves and wristlets.	
	b. Roll glove gauntlet back to provide access to wrist disconnect.	

STEP	PROCEDURE	REMARKS
c.	Place suit wrist disconnect in ENGAGE	
d.	Gloves may be difficult to don. If so, stop gas flow momentarily.	
e.	Insure glove palm restraint is loosened; place hand into glove.	
f.	Aline glove wrist disconnect with suit wrist disconnect and engage both units.	
g.	Insure glove rotates easily and place suit wrist disconnect to LOCK.	
h.	Roll glove gauntlet back over PGA arm.	
i.	Adjust palm restraint as desired. Close cover flap and engage fasteners.	
j.	Similarly don other glove.	
10	Donning LEVA	
a.	Verify that both visors are open or open the visors.	
b.	Disengage latching mechanism through access on LEVA collar.	
c.	Place LEVA over pressure helmet and lower onto helmet-attaching ring.	Aline LEVA by using the projecting PGA feedport as a guide.
d.	Aline separation of plastic collar with helmet "Engaged" alinement marks.	

STEP	PROCEDURE	REMARKS
	e. Insure LEVA is properly located on attaching ring and lock.	
	f. Lower collar and fasten to PGA.	
	CAUTION Collar must conceal helmet-attaching ring area for lunar surface activity only.	
11	Donning helmet protective shield	
	a. Expand shield, slip hole over helmet feedport, rotate opposite side over helmet, and allow to contract in place.	

STEP	PROCEDURE	REMARKS
4.1.4	PGA EV CONFIGURATION DOFFING PROCEDURES	The EMU is assumed to be in the same configuration as at end of extravehicular configuration donning procedures.
1	Doffing EV glove	
a.	Decrease PGA pressure flow to <0.75 psig.	
b.	Roll glove gauntlet back and put wrist disconnect to OPEN position.	
c.	Doff glove.	
d.	Similarly doff other glove.	
2	Doffing LEVA	
a.	Verify both visors in full OPEN position.	
b.	Disengage fastener tapes of LEVA collar.	
c.	Disengage locking mechanism.	
d.	Ease LEVA up and off pressure helmet.	
3	Doffing pressure helmet	
a.	Place helmet-attaching ring in OPEN.	
b.	Ease pressure helmet up and out of helmet-attaching ring.	

STEP	PROCEDURE	REMARKS
4	Doffing ITMG connector cover	
	Unsnap cover and remove.	
5	Doffing PLSS (Step 4.3.2)	
6	Doffing lunar boots	
	a. Unbuckle adjusting strap and unsnap fasteners.	
	b. Slip boots off	
7	Doffing PGA	
	a. Empty UCTA. (See AOH-LM and -CSM procedures.)	
	b. Open slide fastener cover flap.	
	c. Unlock pressure-sealing zipper lock and release slider tab snap fastener.	
	d. Fully OPEN pressure and sealing zippers.	If unassisted, remove donning lanyards from stowage and attach to zipper slider tabs. Grasp blue suit-donning lanyard and pull until the pressure-sealing slider tab is full OPEN and remove suit-donning lanyard. Remove red suit-donning lanyard from lanyard pocket; release restraint slider tab from its stowed position and insert lanyard into slider tab. Grasp the red suit-donning lanyard; pull until the restraint slider is full OPEN and remove the suit-donning lanyard.

STEP	PROCEDURE	REMARKS
	e. Disconnect gas inlet and outlet umbilicals and replace protective covers and caps.	
	f. Grasp PGA at rear-entry area and separate zippers then slip PGA from around back and buttocks.	
	g. Disconnect communications carrier electrical lead. Power off from electrical umbilical.	
	h. Grasp helmet attaching ring, slip head out, and pull both arms away from PGA.	
	i. Disconnect LCG multiple water connector. If LCG is to be doffed, reinstall PGA protective plug.	
	j. Disconnect biomedical electrical connector.	
	k. Disconnect urine connector.	
	l. Remove legs from PGA.	
8	Doffing UCTA (Step 4.1.2-4)	
9	Doffing biomedical harness and belt (Step 4.1.2-5)	See remarks page 4-3, Step 4.1.1-2d.
10	Doffing LCG	
	a. Open front entry.	
	b. Pull bioinstrumentation leads out of LCG front.	
	c. Slip out of LCG.	
11	Doffing FCS (Step 4.1.2-7)	

STEP	PROCEDURE	REMARKS
12	Doffing helmet protective shield	
	a. Expand shield, rotate about helmet feedport, and disengage from feedport.	

4.1 PGA DONNING AND DOFFING

STEP	PROCEDURE	REMARKS
4.2	OPS OPERATIONS	
4.2.1	OPS CHECKOUT	
1	Open access flaps and verify OPS bottle pressure gage reads 5880 ± 500 psia.	
2	Verify OPS O_2 connector locked in stowage plate.	
3	OPS actuation lever — ON.	
4	Verify OPS regulator checkout gage reads 3.70 ± 0.30 psid.	
5	DEPRESS heater test button.	Note the heater test light status.
6	OPS O_2 actuation lever is OFF.	The OPS regulator checkout gage will continue to read 3.7 ± 0.3 psid for approximately 3 minutes after OPS actuation lever is OFF.
7	Secure all access flaps.	
8	Verify OPS regulator checkout gage less than 2.5 psi.	
4.2.2	OPS DONNING PRIOR TO CONTINGENCY TRANSFER	
1	Pull out tear-tack stitches on the PLSS adjustable harness by yanking on endtab until strap is free.	
2	Open thermal cover over strap buckle adjustment; remove retaining spring clip.	

STEP	PROCEDURE	REMARKS
3	Join the fixed waist harness to the adjustable waist harness of the PLSS using the D-buckle under the thermal cover of the adjustable harness (PLSS attachment end) and the hook under the thermal cover on the fixed length strap (PLSS attachment end). The hook on the free end of the straps should be faced inward.	
4	Loop harnesses around the back of PGA and thread through LM tether restraints.	
5	Remove OPS O_2 connector from stowage plate.	
6	Hook harnesses to OPS.	
7	Install OPS oxygen connector (blue) into the top (blue) PGA oxygen connector.	
8	Install purge valve into bottom (red) PGA O_2 connector and verify locked.	
9	Open OPS actuator access flap.	
10	Adjust harnesses to secure OPS. Allow for the expansion of the PGA when pressurized.	
4.2.3	OPS ACTIVATION	
	Move OPS actuation lever from OFF to ON position and allow it to lock.	
4.2.4	OPS DEACTIVATION	
	Move OPS actuation lever from ON to OFF position and allow it to lock.	

STEP	PROCEDURE	REMARKS
4.3	PLSS/OPS DONNING AND DOFFING	
4.3.1	PLSS/OPS DONNING	PGA helmet and gloves off. PGA diverter valves (2) — Horizontal
1	Open access flap, unstow antenna connector, OPS half, secure access flaps.	
2	Lift OPS locking pin.	
3	Slide OPS onto PLSS from left to right while facing PLSS conformal side.	Conformal side of PLSS is the side that conforms to the crewman's back when PLSS is donned.
4	Push locking pin down.	
5	Remove EVCS antenna connector (J5) dust cap.	
6	Connect antenna connector, OPS half to antenna connector, PLSS half. Screw on CW.	
7	Verify sublimator exhaust is clear.	Visual inspection.
8	Unstow PLSS shoulder and waist harnesses.	
9	Unstow PLSS PGA electrical umbilical, inlet and outlet O_2, and multiple water connectors.	
10	Remove battery cable from stowage plate. Rotate battery cable handle CCW (90° to alinement marks).	
11	Remove battery connector (J6) dust cap and stow on battery cable stowage plate.	

STEP	PROCEDURE	REMARKS
12	Connect battery cable to battery.	
	a. Aline marks on battery cable body and handle.	
	b. Aline marks on battery cable handle and battery.	
	c. Connect battery cable to battery connector and rotate handle CW (90°).	
13	Remove dust cap RCU connector (J3), PLSS half. Twist CCW.	
14	Verify OPS actuation lever is OFF and OPS regulator checkout gage reads less than 2.5 psi.	
15	Unstow OPS connector. Pull stowage plate tabs and rotate CCW.	Do not unstow OPS oxygen hose at this time.
16	Secure PLSS/OPS access flaps.	
17	Don PLSS/OPS by securing shoulder and waist harnesses to the PGA upper and lower PLSS brackets.	
18	Connect PLSS inlet and outlet O_2 (red to red, blue to blue) and multiple water connectors to PGA left side and lock. Connect PLSS PGA electrical umbilical and lock.	
19	Before connecting RCU, verify: PLSS pump switch — OFF, PLSS fan switch — OFF, and PLSS mode selector switch — Position 0 (OFF).	

STEP	PROCEDURE	REMARKS
20	Connect RCU electrical connector to the PLSS.	
	a. Aline marks on RCU connector body and handle.	
	b. Aline marks on RCU connector and PLSS, insert, and rotate CW 90°.	
21	Attach RCU to PLSS straps and PGA as follows:	
	a. Pull Velcro strap away from front of RCU.	
	b. Using strap as a grip, pull directly forward of RCU and then down. Release strap to lock in open position.	
	c. Insert lower clip to PGA upper PLSS bracket.	
	d. Raise RCU and insert the left shoulder clip into left RCU clip, then clip the right side.	
	e. To lock clips, pull strap handle forward and up to a horizontal position and release. Verify hooks are locked in closed position.	
	f. Restow Velcro strap handle on front of RCU.	
22	Unstow OPS hose.	
23	Depress OPS actuation lever bracket tab and unstow actuation lever cable.	

STEP	PROCEDURE	REMARKS
24	Attach OPS actuation lever to the RCU. a. Insert lower pins on the OPS actuation lever into the RCU actuation lever bracket slots. b. Push upper portion of the OPS actuation lever toward the bracket until the upper pins engage the bracket and snap locked.	
25	Install OPS connector to the PGA (blue to blue) and lock.	
26	Install purge valve in PGA O_2 connector (red to red).	
27	Secure all PLSS/OPS access flaps and verify gas connector lock locks (4).	
28	Unstow antenna.	
4.3.2	PLSS/OPS DOFFING IN PRESSURIZED ENVIRONMENT	1. Helmet and gloves - Off 2. PLSS feedwater valve - CLOSED (up) 3. PLSS O_2 shutoff valve - OFF (up) 4. LM is at 5 psia. 5. OPS actuation lever is OFF.
1	Remove OPS actuation lever from RCU.	
2	Disconnect RCU from PGA upper PLSS bracket and PLSS shoulder harnesses. a. Pull Velcro strap away from front of RCU. b. Using strap as a grip, pull directly forward of RCU and then down. Release strap to lock in open position.	

STEP	PROCEDURE	REMARKS
	c. Lift RCU from left shoulder strap, then right.	
	d. Lower RCU from PGA upper PLSS bracket.	
	CAUTION Before disconnecting RCU, all electrical PLSS controls must be OFF. PLSS pump switch — OFF PLSS fan switch — OFF PLSS mode selector switch — Position 0 (OFF)	
3	Disconnect RCU electrical umbilical from PLSS by rotating RCU connector handle CCW (90°).	
4	Disconnect inlet and outlet O_2 and multiple water connectors, electrical umbilical connector, and OPS O_2 connector. The electrical umbilical connector is pulled away from the PGA and rotated CCW to remove.	
5	Remove the purge valve and stow.	
6	Remove PLSS shoulder and waist harnesses from the PGA.	
7	Temporarily stow PLSS.	
8	Stow OPS antenna.	

STEP	PROCEDURE	REMARKS
9	Stow OPS actuation lever.	
	a. Insert lower pins on the OPS actuation lever into the OPS actuation lever bracket slots.	
	b. Push upper portion of the OPS actuation lever down until the upper pins engage the bracket and snap locked.	
10	Verify OPS actuation lever is OFF and locked.	
11	Stow OPS O_2 hose and connector; secure OPS access covers.	
	a. Route the hose around the back of the OPS over the actuation lever cable.	
	b. Verify the OPS connector stowage plate is in the open position (CCW).	
	c. Insert the OPS connector and lock the OPS stowage plate connector (twist CW).	
	d. Secure access flaps over OPS hose.	
12	Stow PLSS inlet and outlet O_2 and multiple water hoses and connectors and PLSS PGA electrical umbilical and connector.	

4.3 PLSS/OPS DONNING AND DOFFING

STEP	PROCEDURE	REMARKS
	a. Confirm O_2 water and electrical connector stowage plates are in the open position (CCW).	
	b. Perform stowage routing according to the decal on the PLSS O_2 bottle shield.	
	c. Lock all stowage connectors (twist CW).	
13	Disconnect OPS antenna connector from EVCS by unscrewing CCW.	
14	Replace antenna connector dust cap by pushing straight on.	
15	Lift OPS locking pin to release.	
16	Slide OPS off PLSS from right to left while facing PLSS conformal side.	Conformal side of the PLSS is the side that conforms to the crewman's back when PLSS is donned.
17	Stow antenna connector inside OPS by screwing antenna connector CW on the stowage plate.	
18	Secure OPS access covers.	
19	Replace RCU connector (J3) dust cap by alining marks, inserting, and twisting CW	
20	Restow PLSS shoulder and waist harnesses.	

STEP	PROCEDURE	REMARKS
4.3.3	PLSS/OPS DOFFING IN UNPRESSURIZED ENVIRONMENT	
1	Verify OPS actuation lever OFF.	
2	Disconnect purge valve and stow.	
3	Disconnect OPS O_2 connector.	
4	Connect ECS O_2 umbilicals to PGA (red to red, blue to blue), lock and actuate ECS.	
5	PLSS fan switch — OFF.	
6	PLSS O_2 shutoff valve — OFF (up).	O_2 shutoff handle safety must be depressed as handle is pulled forward.
7	Verify PGA pressure gage reads 3.6 to 4.3 psi.	
	a. PGA diverter valves (2) — horizontal.	
8	PLSS mode selector switch — Position 0 (OFF).	
9	Disconnect PLSS PGA electrical umbilical. The electrical umbilical connector is pulled away from the PGA and rotated CCW to remove. Connect LM communication umbilical.	
10	PLSS feedwater valve — CLOSED (up).	
11	PLSS pump switch — OFF.	
12	Remove OPS actuation lever from the RCU. Depress release lever to free actuation lever upper pins and remove.	

STEP	PROCEDURE	REMARKS
13	Disconnect RCU from PGA upper PLSS bracket and PLSS shoulder harnesses. a. Pull Velcro strap away from front of RCU. b. Using strap as a grip, pull directly forward of RCU and then down. Release strap to lock in open position. c. Lift RCU from left shoulder strap, then right. d. Lower RCU from PGA upper PLSS bracket. CAUTION Before electrically disconnecting RCU, all PLSS electrical controls must be in OFF position. PLSS pump switch — OFF PLSS fan switch — OFF PLSS mode selector switch — Position 0 (OFF)	
14	Disconnect RCU electrical connector from the PLSS. Rotate RCU electrical connector handle CCW to disconnect.	
15	Disconnect PLSS inlet and outlet O_2 and multiple water connectors. Disconnect red O_2 connector first.	

STEP	PROCEDURE	REMARKS
16	Remove waist harnesses from the PGA.	Crewman will require assistance.
	a. Grasp outside loop of right-hand strap between adjustment buckle and PGA hook and tear tack-stitches adjacent to buckle.	
	b. Unsnap harness keeper between adjustment buckle and PLSS hook.	
	c. Grasp exposed end of strap between PLSS hook and adjustment buckle and tear tack-stitches.	
	d. Unsnap adjustment-buckle thermal insulation to expose buckle.	
	e. Grasp buckle roller release tab and rotate outward to release grip on harness. Lengthen the harness by use of the adjustment buckle.	
	f. Unhook right-hand harness from PGA.	
	g. Unhook left-hand harness from PGA.	
17	Remove shoulder harnesses from the PGA.	
18	Temporarily stow the PLSS.	
19	Stow antenna.	
20	Disconnect OPS antenna connector from EVCS. Unscrew CCW.	

STEP	PROCEDURE	REMARKS
21	Stow OPS actuation lever.	
	a. Insert lower pins on the OPS actuation lever into the OPS actuation lever bracket slots.	
	b. Push upper portion of the OPS actuation lever down until the upper pins engage the bracket and snap locked.	
22	Verify OPS actuation lever is OFF and locked.	
23	Stow OPS hose and connector and secure OPS access flaps.	The hose is routed around the back of the OPS over the actuation lever cable and is held in place by the thermal cover. The OPS hose connector stowage plate must be in the open position (full CCW) when the connector is inserted and twisted CW to close.

4.3 PLSS/OPS DONNING AND DOFFING

STEP	PROCEDURE	REMARKS
4.4	PLSS COMMUNICATION CHECK	OPS, RCU, PLSS, and PGA systems are properly connected. PLSS/EVCS modes interface with LM and CM communications subsystems. Spacecraft switch positions for various communications modes (PLSS, SC, MSFN) are found in the AOH for CSM and LM. PLSS switches and valves off.
1	PLSS mode selector switch to Position B.	
2	Verify 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag shows P, low PGA pressure warning flag shows 0.	
3	Read PLSS O_2 gage (percent of full scale).	
4	Verify voice communications. Adjust volume.	Increase volume by rotating blade CCW.
5	PLSS mode selector switch to Position A.	
6	Verify 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag continues to show P. Low PGA pressure warning flag continues to show 0.	
7	Read PLSS O_2 gage (percent of full scale).	
8	Verify voice communications and TM, adjust volume.	Increase volume by rotating wheel CCW.
9	PLSS mode selector switch to position AR.	
10	Verify 1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag shows P. Low PGA pressure warning flag shows 0.	

STEP	PROCEDURE	REMARKS
11	Read PLSS O_2 gage (percent of full scale).	
12	Verify voice communication and TM, adjust volume as required.	

4.4 PLSS COMMUNICATION CHECK

STEP	PROCEDURE	REMARKS
4.5	PRESSURE INTEGRITY CHECK	
4.5.1	PLSS/OPS/PGA PRESSURE INTEGRITY CHECK	EMU donned. Ambient pressure 5.0 psia. PLSS fan in ON. ECS O_2 — OFF. PLSS feedwater valve — CLOSED.
1	PLSS O_2 shutoff valve — ON (down)	
2	Verify PLSS 1.5 kHz warble tone on for 10 seconds. High O_2 flow warning flag shows 0. Low PGA pressure warning flag shows 0 and clears when PGA pressure reaches 3.1 to 3.4 psid.	
3	Verify high O_2 flow warning flag clears as PGA gage reaches 3.85 ± 0.15 psig.	
4	PLSS O_2 shutoff valve — OFF (up).	
5	Read PGA pressure gage and monitor pressure decay for 1 minute. Exercise suit joints during decay period.	
6	EMU circuit decay is not to exceed 0.3 psid.	
7	PLSS O_2 shutoff valve — ON (down).	
8	Verify PGA pressure is 3.85 ± 0.15 psi and all warning flags are clear.	

STEP	PROCEDURE	REMARKS
4.6	PLSS NORMAL OPERATING MODES	
4.6.1	PLSS ACTIVATION	PLSS/OPS donned, helmet and gloves off.
1	PLSS mode selector switch to position AR.	1.5 kHz warble tone on for 10 seconds. Low vent flow warning flag shows P. Low PGA pressure warning flag shows 0. Verify communication and TM.
2	PLSS fan switch — ON.	Verify low vent flow warning flag clear. If fan is activated for more than 30 minutes without PGA cooling, visor fogging may occur.
3	Don helmet and gloves.	
4	PLSS O_2 shutoff valve — ON (down).	
	a. Verify low PGA pressure warning flag clear.	
	b. Verify 1.5 kHz tone for 10 seconds and high O_2 flow warning flag shows 0 and then clear when PGA reaches 3.85 ± 0.15 psig.	
5	PLSS pump switch — ON.	Low feedwater pressure warning tone on and warning flag shows A at 1.3 to 1.6 psia cabin.
6	Verify diverter valve in the MINIMUM position.	
7	PLSS feedwater valve — OPEN (down).	Ambient pressure must be below 1000μ before opening valve.
8	Position PLSS H_2O diverter valve for comfort after low feedwater pressure warning flag clears.	

STEP	PROCEDURE	REMARKS
4.6.2	WET SUBLIMATOR RESTART	PLSS operating. Ambient pressure at vacuum.
1	PLSS feedwater valve is CLOSED (up).	
2	PLSS H_2O diverter valve is at MAXIMUM (down).	
3	Maintain workload to deplete feedwater rapidly.	
4	1.5 kHz warble tone for 10 seconds. Low feedwater pressure warning flag shows A.	
5	After 5 minutes, PLSS H_2O diverter valve is at MINIMUM (up).	
6	PLSS feedwater valve — OPEN (down). Select desired diverter position after low feedwater pressure warning flag clears.	
4.6.3	PLSS DEACTIVATION	EMU donned, PLSS operating. Ambient pressure at vacuum.
1	PLSS water feedwater valve — CLOSED (up).	This is performed prior to repressurization to prevent loss of feedwater when pressure is reestablished. The remaining steps are conducted after the cabin is pressurized.
2	PLSS O_2 shutoff valve — OFF (up).	
3	Pump switch — OFF. PGA pressure is equalized with ambient. Helmet and gloves are doffed.	
4	Fan switch — OFF.	
5	PLSS mode selector switch — Position 0 (OFF).	

STEP	PROCEDURE	REMARKS
4.7	PLSS RECHARGE AND FEEDWATER REMOVAL PROCEDURES	The PLSS recharge procedures consist of battery replacement, LiOH cartridge change, oxygen system recharge, and feedwater reservoir recharge. Oxygen- and feedwater-recharge procedures are given in the LM-AOH.
4.7.1	BATTERY REPLACEMENT	
1	If RCU is connected electrically to the PLSS, all electrical controls must be in OFF position before connecting or disconnecting battery cable. PLSS pump switch — OFF PLSS fan switch — OFF PLSS mode selector switch — Position 0 (OFF)	
2	Rotate PLSS main battery cable 90° CCW and remove from battery. Remove protective cover from main battery cable stowage connector and stow on battery. Depress and rotate battery locking device CCW 90° to unlock battery.	
3	Remove old battery from PLSS and stow.	
4	Obtain replacement battery, remove dust cap, and aline battery on battery foot and slide into place in PLSS.	
5	Depress and rotate battery locking device CW 90° to lock battery in PLSS.	
6	Connect PLSS main battery cable to battery.	

STEP	PROCEDURE	REMARKS
7	Verify battery lift strap snapped in a loop.	
8	Insert PLSS hose stowage strap through lift strap loop and stow.	
4.7.2	LiOH CARTRIDGE CHANGE	
1	Verify PLSS O_2 shutoff valve — OFF.	
2	Remove thermal insulation from the canister cover.	
3	Depress cover lock.	
4	Rotate canister cover CCW until alinement mark on cover is alined with the open mark on canister.	
5	Remove cover by pulling from canister.	
6	Grasp drop handle and rotate contaminant control cartridge CCW until alinement marks on cartridge and canister assembly are alined.	
7	Pull spent contaminant cartridge out of canister.	
8	Obtain replacement cartridge, grasp drop handle, and aline marks, and insert replacement cartridge into canister until it bottoms.	
9	Rotate cartridge CW approximately 90° until marks are alined to lock into position.	

STEP	PROCEDURE	REMARKS
10	Ascertain that alinement marks on both parts of the cover are alined. Grasp cover by handle and depress cover lock.	
11	Aline the alinement marks on canister cover with the "open" mark on cover.	
12	Insert cover in canister.	
13	Rotate cover CW until alinement mark on cover is alined with "closed" mark on canister.	
14	Resnap insulation flap over canister cover.	
4.7.3	PLSS FEEDWATER REMOVAL AND WEIGHING PROCEDURES	
1	Unstow PLSS feedwater collection bag.	
2	Unfold the bag.	
3	Remove the spring scale from the bag side pocket.	
4	Flatten the bag by hand to remove any trapped oxygen.	
5	Remove the H_2O fill connector from the feedwater collection bag connector.	
6	Zero the spring scale with the adjustment knob.	
7	Weigh RCU and record weight in pounds.	

STEP	PROCEDURE	REMARKS
8	Lay the spring scale aside.	
9	Open the PLSS recharge access door to expose the PLSS H_2O fill connector.	
10	Remove the protective cap from the PLSS H_2O fill connector.	
11	Mate the feedwater collection bag to the PLSS H_2O fill connector.	
12	Turn the PLSS O_2 shutoff valve to the ON (down) position.	
13	Allow the O_2 loop to pressurize for 30 seconds.	
14	Turn the PLSS H_2O shutoff and relief valve to the OPEN (down) position.	
15	Allow 1-1/2 minutes minimum for the feedwater bladder to drain.	
16	Turn the PLSS H_2O shutoff and relief valve to the CLOSED (up) position.	
17	Turn the PLSS O_2 shutoff valve to the OFF (up) position.	
18	Disconnect the feedwater collection bag from the PLSS H_2O fill connector.	

STEP	PROCEDURE	REMARKS
19	Attach the protective cap to the PLSS H_2O fill connector.	
20	Close the PLSS recharge access door.	
21	Weigh the feedwater collection bag and contents. Record weight in pounds.	
22	Stow the bag, H_2O fill connector, and scale for jettison.	

4.7 PLSS RECHARGE AND FEEDWATER REMOVAL PROCEDURES

STEP **PROCEDURE** **REMARKS**

4.8 EMU INFLIGHT MAINTENANCE

4.8.1 PGA AND LEVA INFLIGHT EXAMINATION AND MAINTENANCE

This section contains procedures for examining, cleaning, lubricating, and repairing of PGA and LEVA components during flight.

1 PGA and LEVA inflight examination

At a prescribed interval during the mission, each item shall be examined for the conditions outlined in the inflight examination and maintenance schedule. Tasks may be performed earlier than the scheduled intervals at the discretion of the crewman. A detailed examination is not feasible and shall not be attempted. If damage to a component is suspected, a more detailed examination and analysis of the malfunction should be performed.

The term "general condition" implies that the item will be inspected for the following:

a. Loose or broken stitches

b. Rips, snags, and abraded areas

c. Sharp edges and scratches

d. Damaged seals or O-rings

e. Proper position and security of components

STEP	PROCEDURE	REMARKS
	f. Lack of lubrication	
	g. Cleanliness	
	Inflight repairs on items found to be discrepant in general condition are possible in centain instances, dependent upon the provisions of the EMU maintenance kit.	
2	PGA inflight maintenance	
	a. Cleaning and antifog treatment of pressure helmet and helmet shield viewing areas	
	CAUTION Do not clean LEVA because coatings may become damaged.	
	1. Cut antifog containers to open and extract pad.	
	2. Apply film of solution on all viewing areas, using a continuous straight line motion.	
	3. Allow to remain a few minutes	Do not allow film to dry before removing or buffing.
	4. Wipe clean and dry with towel.	
	5. Apply second coat on inner surface of pressure helmet, using clean side of pad.	
	6. Allow to remain a few minutes, wipe dry, and buff with dry towel.	

STEP	PROCEDURE	REMARKS
b.	Lubrication of pressure-sealing zippers CAUTION Avoid excessive use of lubricant and wipe away excess. Insure lubricant does not extend beyond specified lubricating area. 1. Position zipper in full open position. 2. Remove lubricant pad from maintenance kit and spread lubricant thinly and evenly over the exposed outer side and underside of both closures.	
c.	Maintenance of seals and O-rings	All accessible seals and O-rings may be lubricated in flight.
	1. Removal of seal or O-ring Fit the contoured end of the seal removal tool between the seal O-ring and seat. Rotate the tool circumferentially around until the seal O-ring is free of the recess and remove tool and O-ring.	

STEP	PROCEDURE	REMARKS
	2. Inspection of removed seal or O-ring Inspect removed seal and O-ring for cuts, abrasions, or breaks in surface as well as irregularities in shape. If seal and O-ring are not faulty, lubricate and install. Replace if O-ring is faulty.	
	3. Lubrication of seal and O-ring Obtain lubrication pad from maintenance kit. Wipe seal and O-ring with pad, being careful not to get lubricant on any other part of PGA.	
	4. Installation of seal and O-ring	

STEP	PROCEDURE	REMARKS
	Cut the pouch in the maintenance kit to remove replacement seal and O-ring.	
	CAUTION Use care to avoid cutting the seal and O-ring.	
	Remove replacement and lubricate.	
	Install seal and O-ring into opening.	The seal removal tool can be used to facilitate installation of seals.
d.	Bladder Repair	
	Small punctures in the bladder portion of the PGA may be repaired in flight provided the structural integrity of the PGA is not greatly impaired.	Punctures of sufficient magnitude to degrade the restraint quality of the glove bladder may be repaired by a patch. However, the glove will not be used but retained for emergency use.
	Determine location of leakage and obtain a repair patch from maintenance kit.	
	Cut repair patch to desired size. The repair patch shall not extend more than one-fourth inch beyond the damaged area.	
	Remove backing from patch and place adhesive side of patch over damaged area. The patch shall be applied to inside of PGA.	
	Apply pressure to insure positive bond.	

STEP	PROCEDURE	REMARKS
4.8.2	BIOINSTRUMENTATION INFLIGHT REPAIR	
1	Replacement of loose electrode	
a.	Remove all trace of old electrode paste from electrode site.	
b.	Replace existing electrode using paste P/N SEB42100014 and electrode attachment assembly P/N SEB42150035.	Located in medical accessories kit
c.	Cover electrode with micropore covering P/N SB-AE-005408.	
2	Replacement of electrode harness	
a.	Obtain spare electrode harness and attached each electrode as described in Step 4.8.2-1.	Located in medical accessories kit
b.	Attach electrode harness to signal conditioners. The connectors should be finger-tight. CAUTION Do not overtighten connectors.	
3	Permanent removal of bioinstrumentation system	
	Remove bioinstrumentation system and cover exposed end of the PGA electrical umbilical and/or T-adapter cable with tape P/N SEB12100050-201 (on board).	

STEP	PROCEDURE	REMARKS
4.9	PURGE VALVE OPERATION	
4.9.1	ACTIVATION PROCEDURES FOR PURGE VALVE	
1	Remove pull pin by grasping the red apple and pulling with about 20 pound of force.	
2	Squeeze the two locktabs on the purge valve barrel simultaneously. The valve will now pop open.	
4.9.2	SHUTOFF PROCEDURES	
1	Squeeze the two locktabs simultaneously and push in the purge valve barrel.	
2	Release the locktabs while still pushing on the barrel until the locktabs are engaged.	
3	Confirm purge valve closing, either by flow changes or by visually confirming the barrel is no longer extended.	
4.9.3	PURGE VALVE REMOVAL PROCEDURES	
1	Release gas connector lock-lock.	
2	Lift gas connector locktabs and rotate to release position.	
3	Remove purge valve from gas connector.	

4.9 PURGE VALVE OPERATION

STEP	PROCEDURE	REMARKS
4.10	MISCELLANEOUS PROCEDURES	
4.10.1	PLSS GAS TRAP ACTIVATION	
1	EV activation (by other crewman)	
a.	Shift PLSS to extreme left.	
b.	Open gas trap guard.	
c.	Depress gas trap button for 5 seconds then release.	Cooling should be improved in 3 minutes.
d.	Close guard.	
e.	Realine PLSS.	
2	Pressurized cabin activation — PLSS doffed	
a.	Connect PLSS multiple water connector to suit connector.	
b.	Switch pump to ON.	
c.	Cycle diverter valve slowly (three times).	
d.	Switch pump to OFF.	
e.	Disconnect multiple water connector from suit.	
f.	Connect LM water supply hose to PLSS fill connector and open supply valve.	
g.	Open gas trap guard.	

STEP	PROCEDURE	REMARKS
	h. Depress gas trap button until water is observed at the vent on top of the gas trap then release.	
	i. Close guard.	
	j. Close LM water supply valve and disconnect supply hose.	
	k. Close PLSS fill cover.	
4.10.2	CAMERA MOUNTING/RCU	
1	Outside LM beginning of EVA	
	a. Crewman receives camera with mounting bracket attached.	
	b. Crewman will place the camera bracket (female) and center the base directly center of the RCU and mate the two brackets (camera and RCU halves).	
	c. Push camera and bracket down until lock is in place.	
2	Release of camera and bracket (assumes crewman unassisted)	
	a. Place right hand under camera and bracket and apply a small force upward.	
	b. Place left thumb or forefinger on tab release lever on front of RCU.	
	c. Push release lever to the right while applying upward force from base of camera and lift camera from RCU mounting.	

SECTION 5

EMU

MALFUNCTION PROCEDURES

5.1 INTRODUCTION

5.1.1 The malfunction procedures encompass the recognition, diagnosis and corrective action for system malfunctions. In most cases, the crew is alerted to a malfunction condition by indicators and gages. The malfunction analyses do not contain solutions; such solutions are found in Mission Rules. The procedures in this section cover significant single failures, and are not intended to replace the detailed Failure Modes-Effects Analyses published in other documents.

5.1.2 The malfunction procedures are for use during Apollo missions where an EMU having an SV 706100-6 PLSS (without a CO_2 sensor) will be worn. The procedures have been classified as (1) emergency, (2) EVA, and (3) post-EVA.

5.1.3 For maximum safety, all emergency procedures should be memorized so action can be taken immediately when the malfunction occurs. The EVA procedures do not need to be memorized since they are provided through voice communications, except for steps which cover EVA procedures for loss of voice communications.

5.1.4 The post-EVA procedures are designed to extract a maximum amount of information on any observed anomaly, since the PLSS/OPS and associated hardware would not normally be returned to earth for postflight analysis.

5.1.5 The procedures and remarks are representative of a nominal EMU. Values and quantities which are characteristic of an individual EMU, and which can be established only by testing the actual EMU to be used in the flight, are underlined in each case.

5.2 FORMAT OF PROCEDURES

The malfunction procedures are presented in a three-column, logic flow diagram format. A description and use of each of these columns is as follows:

SYMPTOM	The primary purpose of the symptom column is to give "First Indication" of the malfunction as received by either the crew or telemetry. The possible causes of the malfunction are indicated in this column.
PROCEDURE	The procedures column presents a step-by-step logic flow diagram of actions and decisions used to isolate or correct a malfunction symptom. The remote-event number symbols are used to reference items to the "Remarks" column or to refer to other procedural steps.
REMARKS	This column will include the following information: a. Amplifying additional remarks related to the symptom, such as relief valve vents at ______psid. b. Amplifying remarks which relate to a decision and/or action items. c. Explaining resultant system status or operational capability after a failure has been identified. d. Cautions or warnings, as necessary, to cover conditions that may exist because of a failure.

5.3 MALFUNCTION SYMPTOMS FOR EMU USING PLSS SV 706100-6

Symptom Page

EMU 1 - Warning tone and low vent flow flag "P" 5-4

EMU 2 - Warning tone and low PGA pressure flag "O". 5-6

EMU 3 - Warning tone and high O_2 flow flag "O". 5-10

EMU 4 - Warning tone and low feedwater pressure flag "A". 5-12

EMU 5 - Warning tone with no warning flags 5-14

EMU 6 - PGA pressure gage <3.7 psid and apparently stable (no warning tone) 5-16

EMU 7 - PLSS O_2 quantity indicator abnormal reading 5-17

EMU 8 - PGA pressure gage >4.0 psid 5-19

EMU 9 - Loss of pump noise 5-20

EMU 10 - Inadequate cooling of crewman (diverter valve - MAX. cooling) 5-21

EMU 11 - EVA-1 loses voice from MSFN (EVA-1 has voice from EVA-2) 5-23

EMU 12 - EVA-1 loses voice from MSFN (EVA-1 does not have voice from EVA-2) 5-24

EMU 13 - EVA-1 loses voice from EVA-2 (EVA-1 has voice from MSFN) 5-26

EMU 14 - EVA-2 loses voice from MSFN (EVA-2 receives voice from EVA-1) 5-28

EMU 15 - EVA-2 loses voice from MSFN (EVA-2 does not have voice from EVA-1) 5-29

EMU 16 - EVA-2 loses voice from EVA-1 (EVA-2 has comm. with MSFN) 5-31

EMU 17 - Loss of voice comm. with EVA-1, EVA-2, or MSFN (two-man EVA) (comm. restoration procedure) . . . 5-33

EMU 18 - EVA loses voice from LM 5-34

Symptom Page

EMU 19 - LM loses voice from EVA 5-36

EMU 20 - GT8168P/GT8268P PGA pressure <3.7 psid and apparently stable (no warning tone) 5-38

EMU 21 - GT8168P/GT8268P PGA pressure >4.0 psid 5-40

EMU 22 - GT8182P/GT8282P PLSS O_2 pressure abnormal 5-41

EMU 23 - GT8182P/GT8282P PLSS O_2 pressure <800 psia (pre-EVA) 5-43

EMU 24 - GT8182P/GT8282P PLSS O_2 pressure <350 psia (post-EVA) 5-44

EMU 25 - GT8110P/GT8210P feedwater pressure <1.8 psid (no warning tone) 5-45

EMU 26 - GT8154T/GT8254T LCG H_2O temperature >68° F with diverter valve in MAX. cooling 5-47

EMU 27 - GT8196T/GT8296T LCG H_2O ΔT >11° F (MAX. diverter valve position) 5-48

EMU 28 - GT8140C/GT8240C PLSS battery current >3.0 amps 5-50

EMU 29 - GT8140C/GT8240C PLSS battery current <2.3 amps (no warning tone) 5-52

EMU 30 - GT8141V/GT8241V PLSS battery voltage ≤16.0 Vdc (no warning tone) 5-54

EMU 31 - GT8170T/GT8270T O_2 temperature <38° F (no warning tone) 5-56

EMU 32 - GT8170T/GT8270T O_2 temperature >52° F (no warning tone) 5-57

SYMPTOM	PROCEDURE	REMARKS

EMU 1

Warning tone ON and low vent flow flag "P"

Actuating parameter:
Vent flow
<4.0 to 5.3
acfm for >5 sec

Possible causes:

a. Fan OFF or degraded

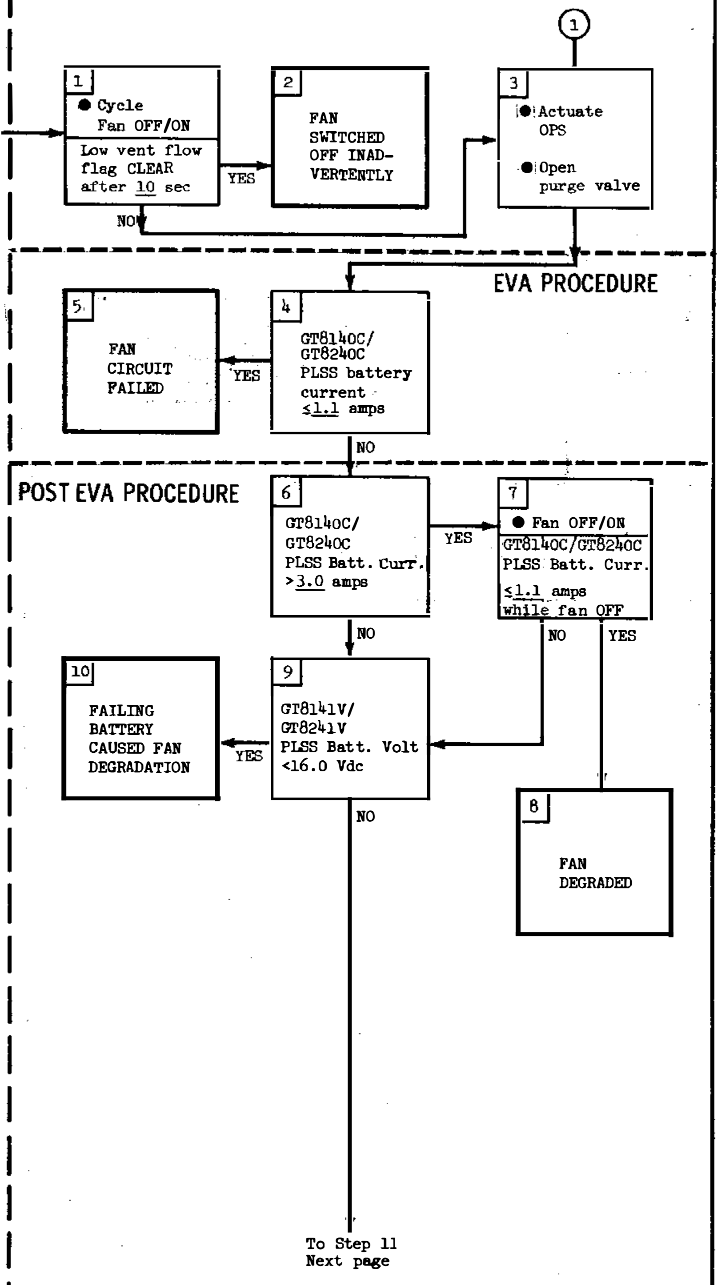
b. Battery degraded

c. High PGA ΔP

d. Low vent flow sensor failed on or shifted set point

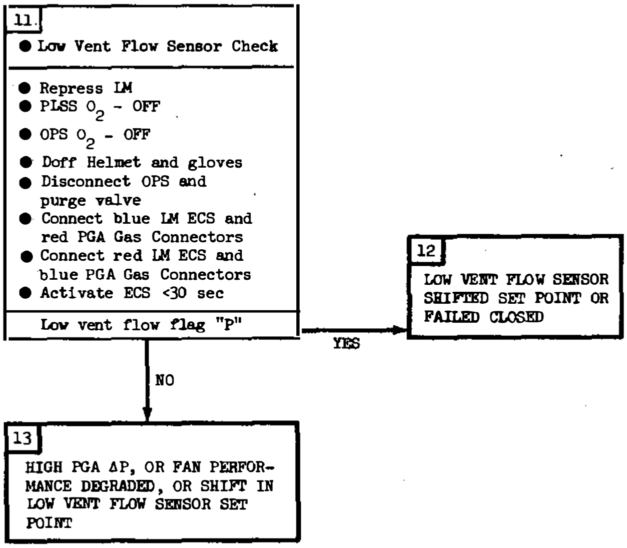
e. Flow restriction in PLSS vent loop

EMERGENCY PROCEDURE


①
1
● Cycle Fan OFF/ON
Low vent flow flag CLEAR after 10 sec
YES
NO
2
FAN SWITCHED OFF INADVERTENTLY
3
● Actuate OPS
● Open purge valve
EVA PROCEDURE
4
GT8140C/ GT8240C PLSS battery current ≤1.1 amps
YES
5
FAN CIRCUIT FAILED
NO
POST EVA PROCEDURE
6
GT8140C/ GT8240C PLSS Batt. Curr. >3.0 amps
YES
7
● Fan OFF/ON
GT8140C/GT8240C PLSS Batt. Curr. ≤1.1 amps while fan OFF
NO
YES
8
FAN DEGRADED
NO
9
GT8141V/ GT8241V PLSS Batt. Volt <16.0 Vdc
YES
10
FAILING BATTERY CAUSED FAN DEGRADATION
NO
To Step 11 Next page

① The OPS regulates at 3.7 ± 0.3 psid.

A full OPS will provide a minimum of 30 min operation at 8 lb/hr flow at 50° to 80° F inlet temperature with purge valve open.

SYMPTOM	PROCEDURE	REMARKS
	POST EVA PROCEDURE (continued) 	

11
● Low Vent Flow Sensor Check
● Repress LM
● PLSS O_2 - OFF
● OPS O_2 - OFF
● Doff Helmet and gloves
● Disconnect OPS and purge valve
● Connect blue LM ECS and red PGA Gas Connectors
● Connect red LM ECS and blue PGA Gas Connectors
● Activate ECS <30 sec
Low vent flow flag "P"
YES
12
LOW VENT FLOW SENSOR SHIFTED SET POINT OR FAILED CLOSED
NO
13
HIGH PGA ΔP, OR FAN PERFORMANCE DEGRADED, OR SHIFT IN LOW VENT FLOW SENSOR SET POINT

SYMPTOM	PROCEDURE	REMARKS

EMU 2

EMERGENCY PROCEDURE

Warning tone ON and low PGA pressure flag "O"

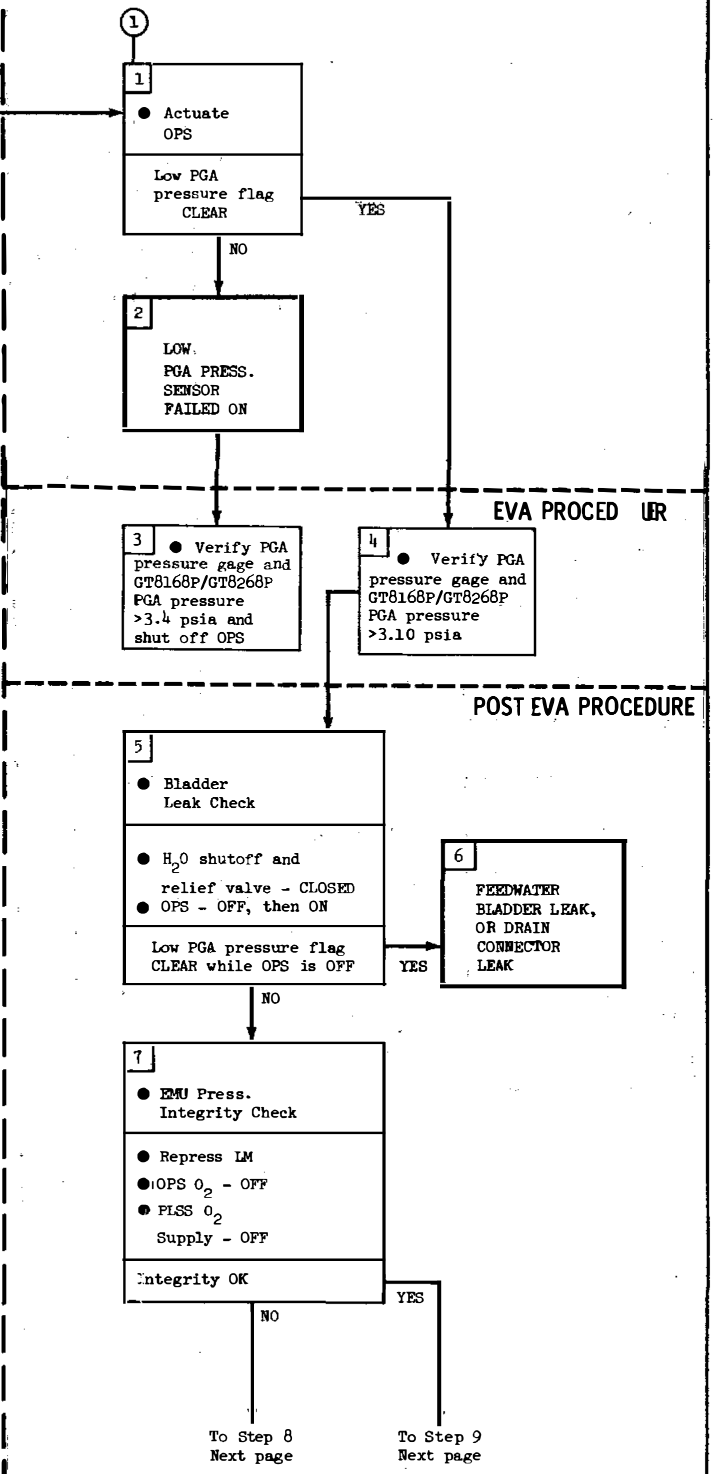
Actuating parameter: PGA Pressure <3.25 ± 0.15 psid

Possible causes:

a. EMU leak

b. Low PGA Pressure sensor failed ON

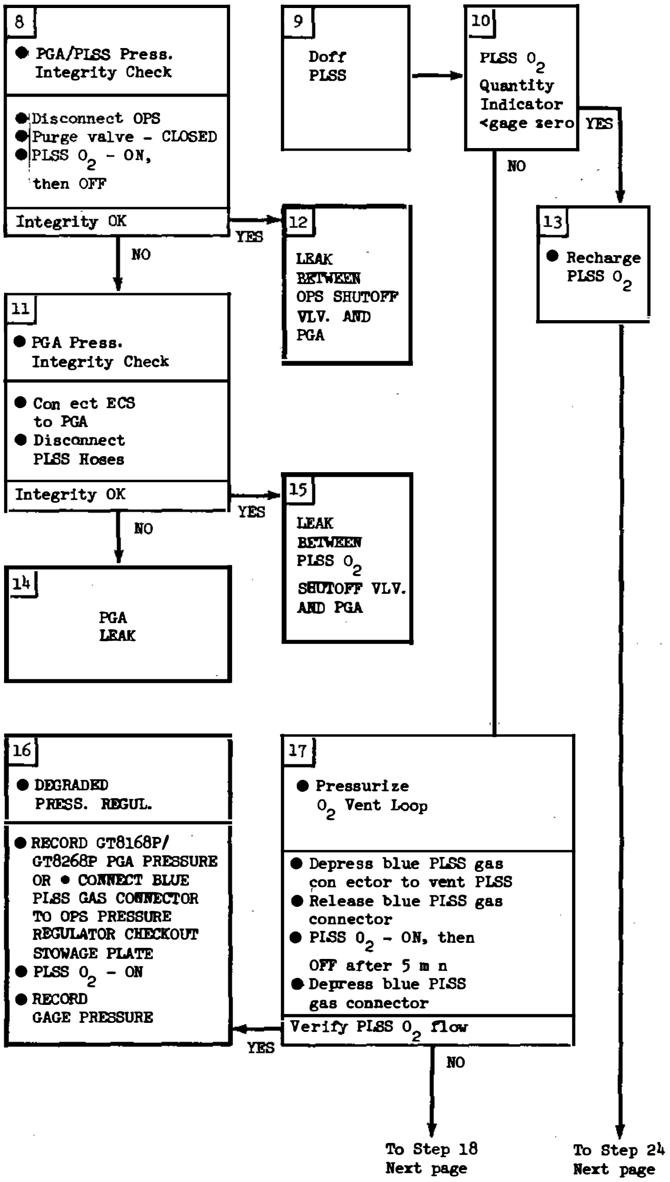
c. PLSS O_2 regulator shifted set point or failed closed


①
1
● Actuate OPS
Low PGA pressure flag CLEAR
YES
NO
2
LOW PGA PRESS. SENSOR FAILED ON
EVA PROCEDURE
3
● Verify PGA pressure gage and GT8168P/GT8268P PGA pressure >3.4 psia and shut off OPS
4
● Verify PGA pressure gage and GT8168P/GT8268P PGA pressure >3.10 psia
POST EVA PROCEDURE
5
● Bladder Leak Check
● H2O shutoff and relief valve - CLOSED
● OPS - OFF, then ON
Low PGA pressure flag CLEAR while OPS is OFF
YES
NO
6
FEEDWATER BLADDER LEAK, OR DRAIN CONNECTOR LEAK
7
● EMU Press. Integrity Check
● Repress LM
● OPS O2 - OFF
● PLSS O2 Supply - OFF
Integrity OK
YES
NO
To Step 8 Next page
To Step 9 Next page

① OPS regulates at 3.7 ± 0.3 psid.

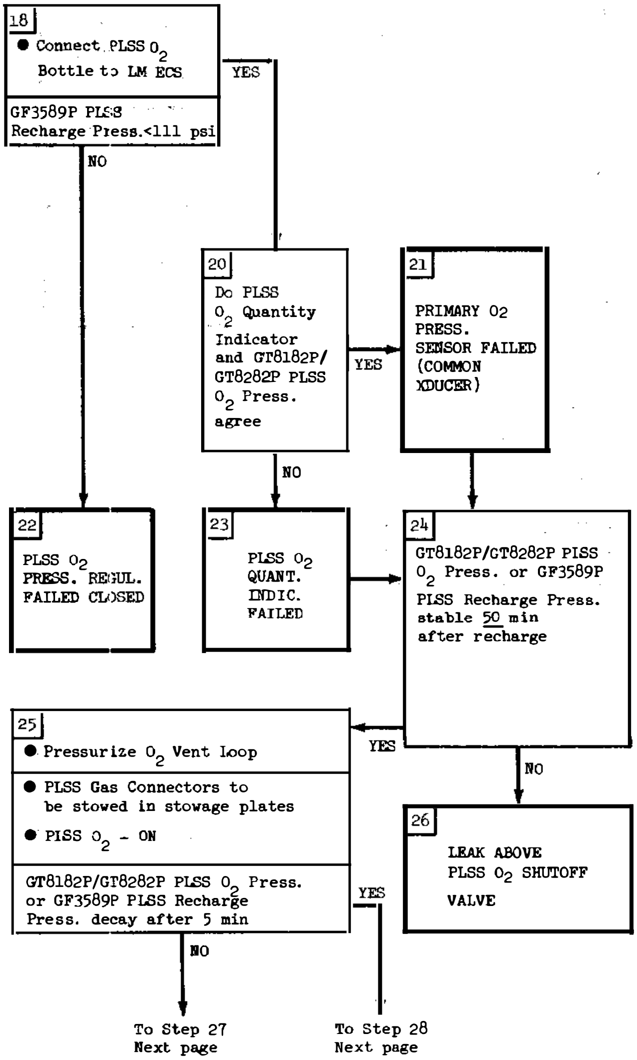
SYMPTOM | PROCEDURE | REMARKS

POST EVA PROCEDURE (continued)


8
● PGA/PLSS Press. Integrity Check
● Disconnect OPS
● Purge valve - CLOSED
● PLSS O_2 - ON, then OFF
Integrity OK
YES
NO
9
Doff PLSS
10
PLSS O_2 Quantity Indicator <gage zero
YES
NO
12
LEAK BETWEEN OPS SHUTOFF VLV. AND PGA
13
● Recharge PLSS O_2
11
● PGA Press. Integrity Check
● Connect ECS to PGA
● Disconnect PLSS Hoses
Integrity OK
YES
NO
15
LEAK BETWEEN PLSS O_2 SHUTOFF VLV. AND PGA
14
PGA LEAK
16
● DEGRADED PRESS. REGUL.
● RECORD GT8168P/GT8268P PGA PRESSURE OR ● CONNECT BLUE PLSS GAS CONNECTOR TO OPS PRESSURE REGULATOR CHECKOUT STOWAGE PLATE
● PLSS O_2 - ON
● RECORD GAGE PRESSURE
17
● Pressurize O_2 Vent Loop
● Depress blue PLSS gas connector to vent PLSS
● Release blue PLSS gas connector
● PLSS O_2 - ON, then OFF after 5 min
● Depress blue PLSS gas connector
Verify PLSS O_2 flow
YES
NO
To Step 18 Next page
To Step 24 Next page

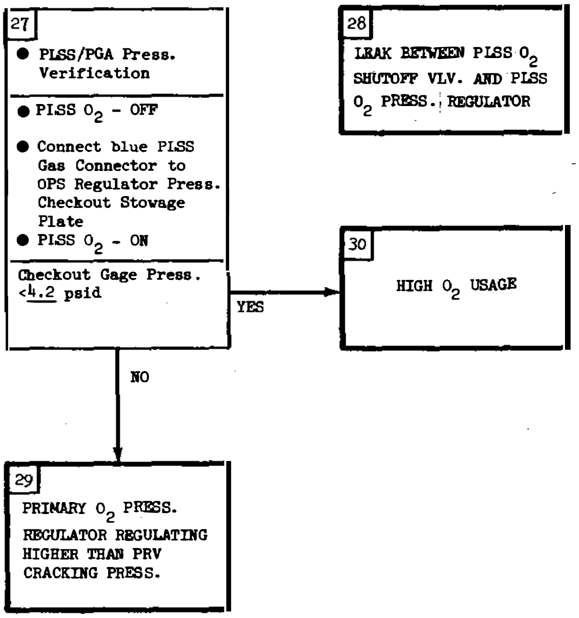
SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE (continued)


18
● Connect PLSS O_2 Bottle to LM ECS
GF3589P PLSS Recharge Press.<111 psi
YES
NO
20
Do PLSS O_2 Quantity Indicator and GT8182P/GT8282P PLSS O_2 Press. agree
YES
NO
21
PRIMARY O_2 PRESS. SENSOR FAILED (COMMON XDUCER)
22
PLSS O_2 PRESS. REGUL. FAILED CLOSED
23
PLSS O_2 QUANT. INDIC. FAILED
24
GT8182P/GT8282P PLSS O_2 Press. or GF3589P PLSS Recharge Press. stable 50 min after recharge
YES
NO
25
● Pressurize O_2 Vent Loop
● PLSS Gas Connectors to be stowed in stowage plates
● PLSS O_2 - ON
GT8182P/GT8282P PLSS O_2 Press. or GF3589P PLSS Recharge Press. decay after 5 min
YES
NO
26
LEAK ABOVE PLSS O_2 SHUTOFF VALVE
To Step 27 Next page
To Step 28 Next page

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE (continued)


27
● PLSS/PGA Press. Verification
● PLSS O_2 - OFF
● Connect blue PLSS Gas Connector to OPS Regulator Press. Checkout Stowage Plate
● PLSS O_2 - ON
Checkout Gage Press. <4.2 psid
YES
NO
28
LEAK BETWEEN PLSS O_2 SHUTOFF VLV. AND PLSS O_2 PRESS. REGULATOR
30
HIGH O_2 USAGE
29
PRIMARY O_2 PRESS. REGULATOR REGULATING HIGHER THAN PRV CRACKING PRESS.

SYMPTOM | **PROCEDURE** | **REMARKS**

EMU 3

Warning tone ON and high O_2 flow flag "O"

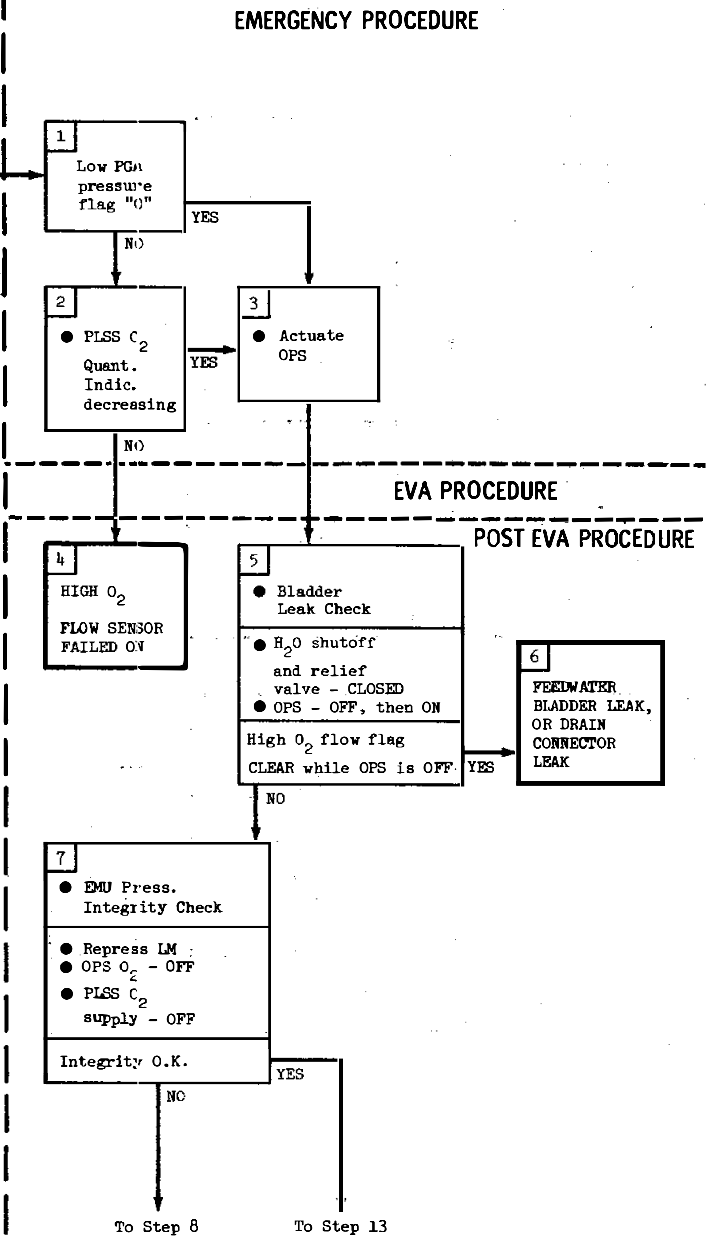
Actuating parameter:
PLSS O_2 flow
>0.50 to 0.65 lb/hr
for >5 sec

Possible causes:

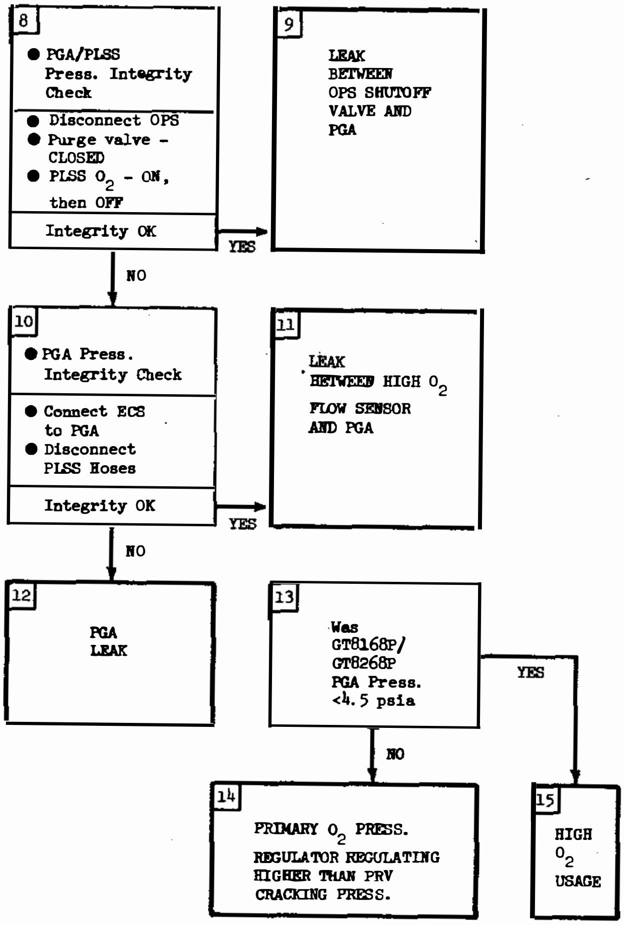
a EMU leak

b. Primary O_2 pressure regulator regulating higher than PRV cracking pressure

c. High O_2 flow sensor failed on


EMERGENCY PROCEDURE
1
Low PGA pressure flag "O"
YES
NO
2
● PLSS O_2 Quant. Indic. decreasing
YES
3
● Actuate OPS
NO
EVA PROCEDURE
POST EVA PROCEDURE
4
HIGH O_2 FLOW SENSOR FAILED ON
5
● Bladder Leak Check
● H_2O shutoff and relief valve - CLOSED
● OPS - OFF, then ON
High O_2 flow flag CLEAR while OPS is OFF
YES
6
FEEDWATER BLADDER LEAK, OR DRAIN CONNECTOR LEAK
NO
7
● EMU Press. Integrity Check
● Repress LM
● OPS O_2 - OFF
● PLSS O_2 supply - OFF
Integrity O.K.
YES
NO
To Step 8 Next page
To Step 13 Next page

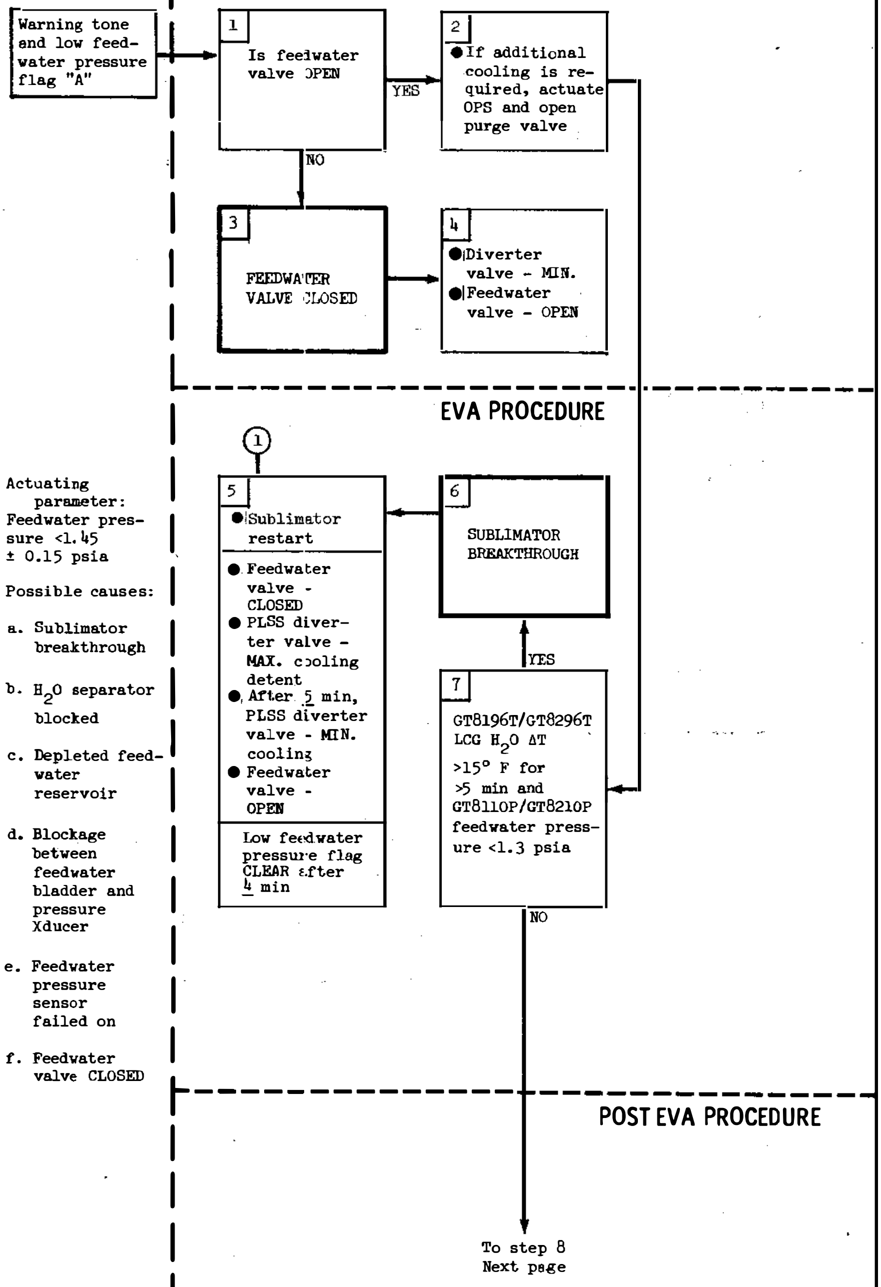
SYMPTOM	PROCEDURE	REMARKS
	POST EVA PROCEDURE (continued)	


8
● PGA/PLSS Press. Integrity Check
● Disconnect OPS
● Purge valve - CLOSED
● PLSS O_2 - ON, then OFF
Integrity OK
YES
9
LEAK BETWEEN OPS SHUTOFF VALVE AND PGA
NO
10
● PGA Press. Integrity Check
● Connect ECS to PGA
● Disconnect PLSS Hoses
Integrity OK
YES
11
LEAK BETWEEN HIGH O_2 FLOW SENSOR AND PGA
NO
12
PGA LEAK
13
Was GT8168P/ GT8268P PGA Press. <4.5 psia
YES
NO
14
PRIMARY O_2 PRESS. REGULATOR REGULATING HIGHER THAN PRV CRACKING PRESS.
15
HIGH O_2 USAGE

SYMPTOM	PROCEDURE	REMARKS

EMU 4

EMERGENCY PROCEDURE


Warning tone and low feedwater pressure flag "A"
1
Is feedwater valve OPEN
YES
NO
2
● If additional cooling is required, actuate OPS and open purge valve
3
FEEDWATER VALVE CLOSED
4
● Diverter valve - MIN.
● Feedwater valve - OPEN
EVA PROCEDURE
①
5
● Sublimator restart
● Feedwater valve - CLOSED
● PLSS diverter valve - MAX. cooling detent
● After 5 min, PLSS diverter valve - MIN. cooling
● Feedwater valve - OPEN
Low feedwater pressure flag CLEAR after 4 min
6
SUBLIMATOR BREAKTHROUGH
YES
7
GT8196T/GT8296T LCG H2O ΔT >15° F for >5 min and GT8110P/GT8210P feedwater pressure <1.3 psia
NO
POST EVA PROCEDURE
To step 8
Next page

Actuating parameter: Feedwater pressure <1.45 ± 0.15 psia

Possible causes:

a. Sublimator breakthrough

b. H_2O separator blocked

c. Depleted feedwater reservoir

d. Blockage between feedwater bladder and pressure Xducer

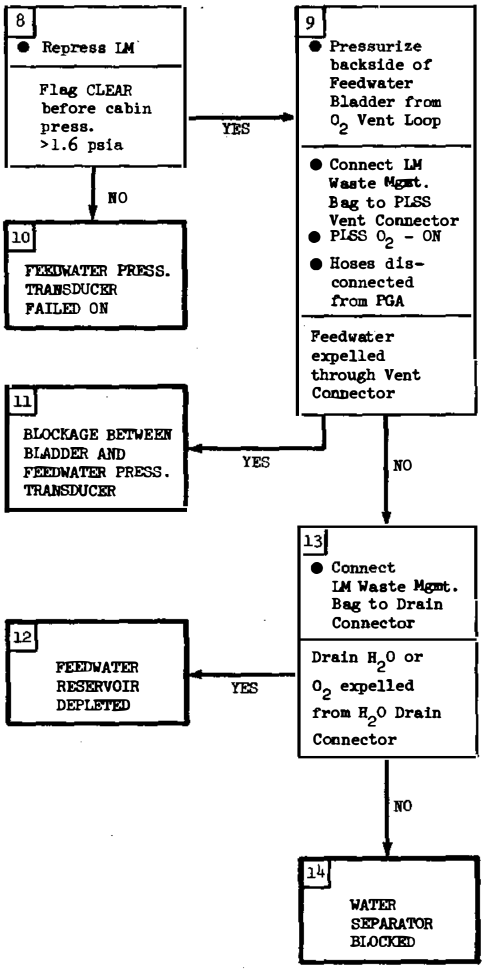
e. Feedwater pressure sensor failed on

f. Feedwater valve CLOSED

① The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE


8
● Repress LM
Flag CLEAR before cabin press. >1.6 psia
YES
NO
9
● Pressurize backside of Feedwater Bladder from O_2 Vent Loop
● Connect LM Waste Mgmt. Bag to PLSS Vent Connector
● PLSS O_2 - ON
● Hoses disconnected from PGA
Feedwater expelled through Vent Connector
10
FEEDWATER PRESS. TRANSDUCER FAILED ON
11
BLOCKAGE BETWEEN BLADDER AND FEEDWATER PRESS. TRANSDUCER
YES
NO
13
● Connect LM Waste Mgmt. Bag to Drain Connector
Drain H_2O or O_2 expelled from H_2O Drain Connector
12
FEEDWATER RESERVOIR DEPLETED
YES
NO
14
WATER SEPARATOR BLOCKED

SYMPTOM | **PROCEDURE** | **REMARKS**

EMU 5

EMERGENCY PROCEDURE

Warning tone with all warning flags CLEAR

Actuating parameters:

Vent flow >4.0 to 5.3 acfm for >5 sec

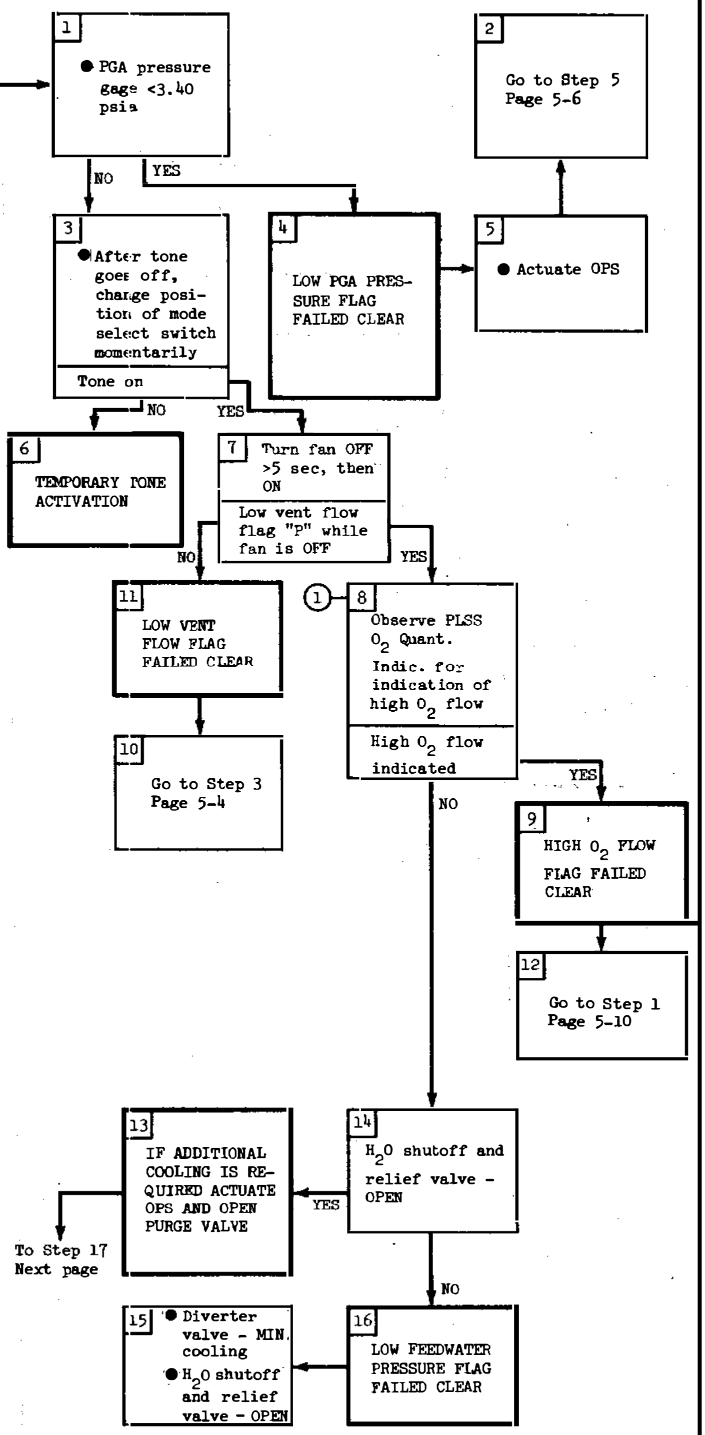
PGA pressure >3.10 to 3.40 psia

PLSS O_2 flow >0.50 to 0.65 lb/hr for >5 sec

Feedwater pressure >1.30 to 1.60 psia

Possible causes:

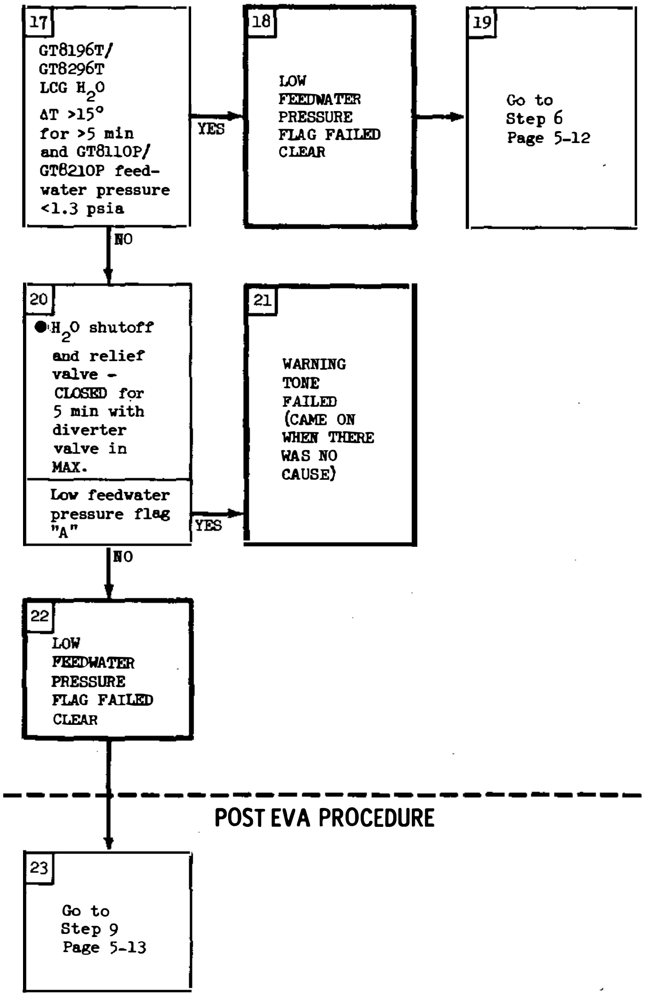
- a. Tone failure
- b. Low vent flow
- c. Low PGA pressure
- d. High PLSS O_2 flow
- e. Low feedwater pressure


1
● PGA pressure gage <3.40 psia
NO
YES
2
Go to Step 5 Page 5-6
3
● After tone goes off, change position of mode select switch momentarily
Tone on
4
LOW PGA PRESSURE FLAG FAILED CLEAR
5
● Actuate OPS
NO
YES
6
TEMPORARY TONE ACTIVATION
7
Turn fan OFF >5 sec, then ON
Low vent flow flag "P" while fan is OFF
NO
YES
11
LOW VENT FLOW FLAG FAILED CLEAR
①
8
Observe PLSS O_2 Quant. Indic. for indication of high O_2 flow
High O_2 flow indicated
YES
NO
10
Go to Step 3 Page 5-4
9
HIGH O_2 FLOW FLAG FAILED CLEAR
12
Go to Step 1 Page 5-10
13
IF ADDITIONAL COOLING IS REQUIRED ACTUATE OPS AND OPEN PURGE VALVE
14
H_2O shutoff and relief valve - OPEN
YES
To Step 17 Next page
NO
15
● Diverter valve - MIN. cooling
● H_2O shutoff and relief valve - OPEN
16
LOW FEEDWATER PRESSURE FLAG FAILED CLEAR

① TM and voice communications should be used to aid in this determination.

SYMPTOM	PROCEDURE	REMARKS

EVA PROCEDURE


17
GT8196T/ GT8296T LCG H_2O ΔT >15° for >5 min and GT8110P/ GT8210P feed-water pressure <1.3 psia
YES
18
LOW FEEDWATER PRESSURE FLAG FAILED CLEAR
19
Go to Step 6 Page 5-12
NO
20
● H_2O shutoff and relief valve - CLOSED for 5 min with diverter valve in MAX.
Low feedwater pressure flag "A"
YES
21
WARNING TONE FAILED (CAME ON WHEN THERE WAS NO CAUSE)
NO
22
LOW FEEDWATER PRESSURE FLAG FAILED CLEAR
POST EVA PROCEDURE
23
Go to Step 9 Page 5-13

SYMPTOM	PROCEDURE	REMARKS
EMU 6	**EMERGENCY PROCEDURE**	

①

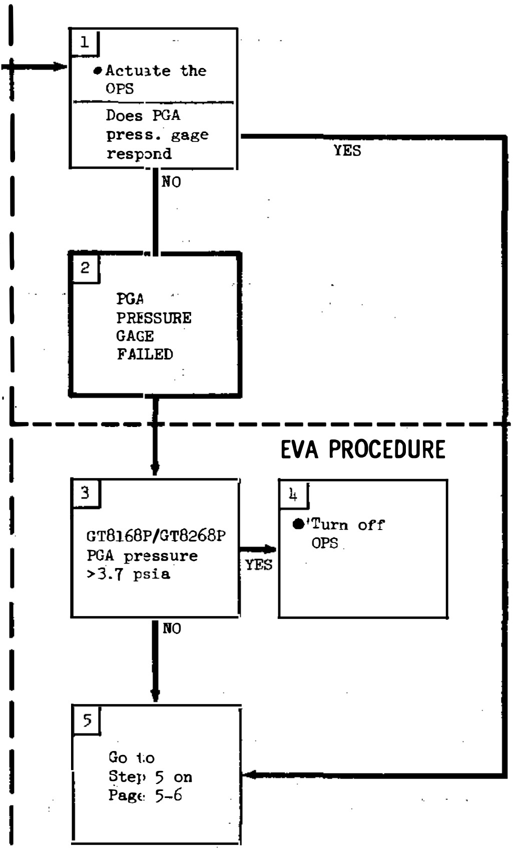
PGA pressure gage <3.7 psid and apparently stable (with no warning tone and warning flags clear)

Possible causes;

a. Gage shift or failure

b. PLSS O_2 regulator shift/ degraded

c. EMU leak



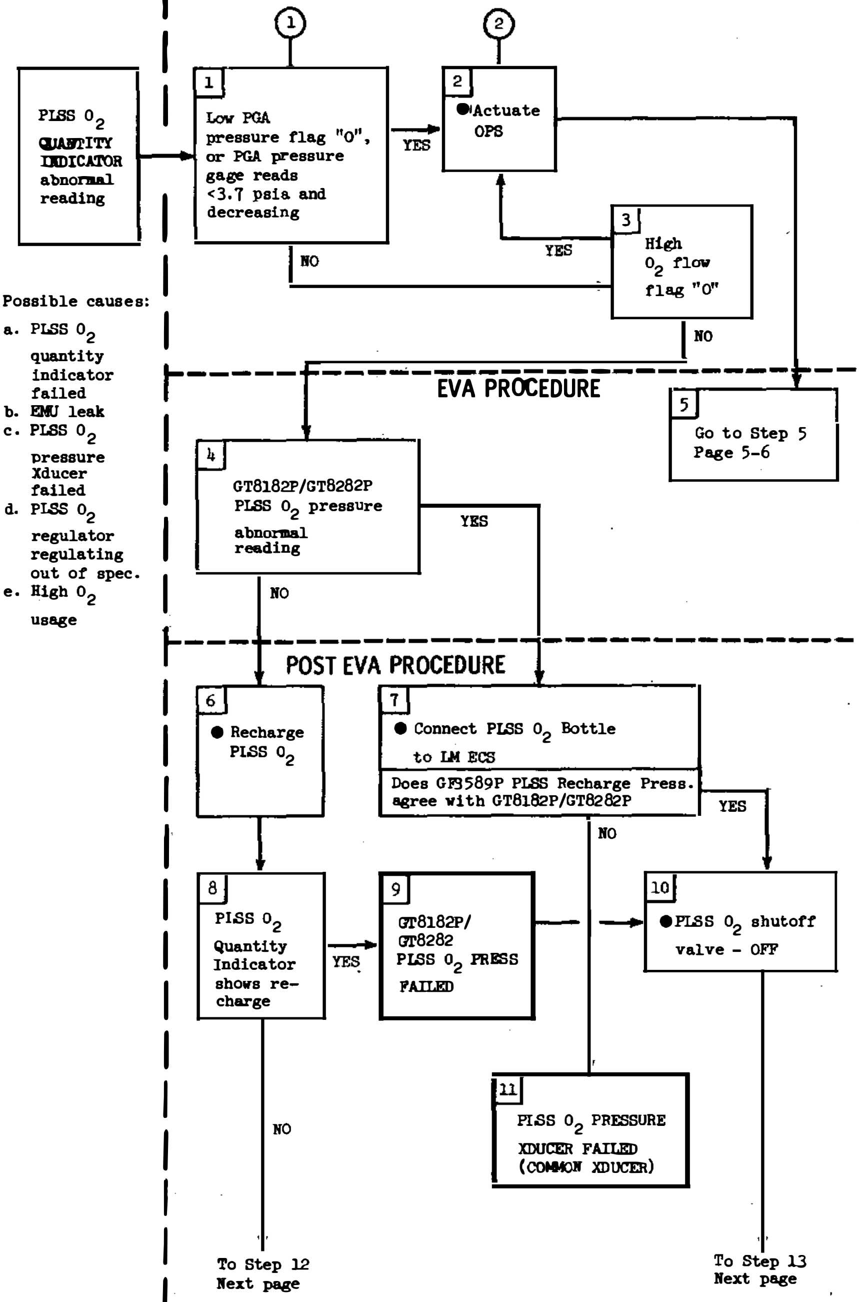
①

PLSS O_2 pressure regulator regulates the PGA to 3.7 psid minimum if flow is 0.07 to 0.7 lb/hr.

SYMPTOM	PROCEDURE	REMARKS

EMU 7

EMERGENCY PROCEDURE


PLSS O_2 QUANTITY INDICATOR abnormal reading
①
1 Low PGA pressure flag "O", or PGA pressure gage reads <3.7 psia and decreasing
YES
NO
②
2 ● Actuate OPS
3 High O_2 flow flag "O"
YES
NO
EVA PROCEDURE
4 GT8182P/GT8282P PLSS O_2 pressure abnormal reading
YES
NO
5 Go to Step 5 Page 5-6
POST EVA PROCEDURE
6 ● Recharge PLSS O_2
7 ● Connect PLSS O_2 Bottle to LM ECS
Does GF3589P PLSS Recharge Press. agree with GT8182P/GT8282P
YES
NO
8 PLSS O_2 Quantity Indicator shows recharge
YES
NO
9 GT8182P/GT8282 PLSS O_2 PRESS FAILED
10 ● PLSS O_2 shutoff valve - OFF
11 PLSS O_2 PRESSURE XDUCER FAILED (COMMON XDUCER)
To Step 12 Next page
To Step 13 Next page

Possible causes:

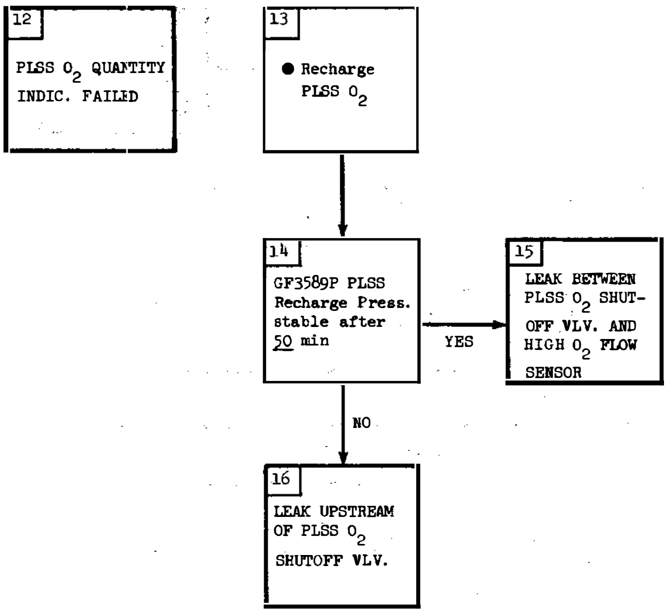
a. PLSS O_2 quantity indicator failed
b. EMU leak
c. PLSS O_2 pressure Xducer failed
d. PLSS O_2 regulator regulating out of spec.
e. High O_2 usage

① 1600 Btu/hr metabolic load plus allowable EMU leakage consumes approximately 0.25 lb/hr O_2. Without makeup O_2, this will reduce PGA pressure to 3 psia in approximately 3 min.

② OPS regulates at 3.7 ± 0.3 psid.

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE (continued)


12
PLSS O_2 QUANTITY INDIC. FAILED
13
● Recharge PLSS O_2
14
GF3589P PLSS Recharge Press. stable after 50 min
YES
15
LEAK BETWEEN PLSS O_2 SHUT-OFF VLV. AND HIGH O_2 FLOW SENSOR
NO
16
LEAK UPSTREAM OF PLSS O_2 SHUTOFF VLV.

SYMPTOM

EMU 8

①

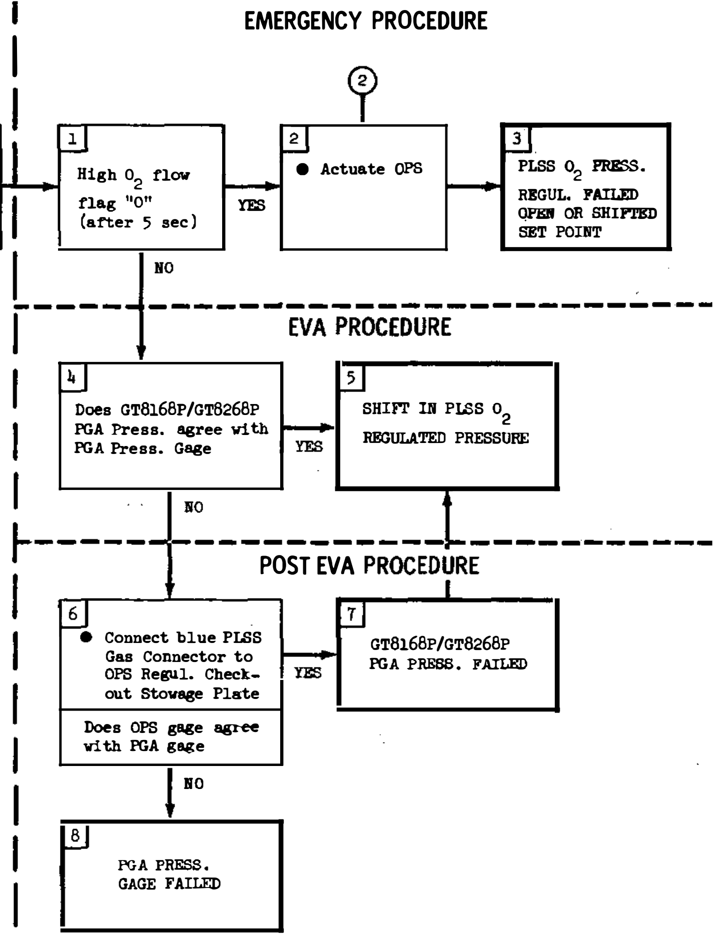
PGA pressure gage >4.0 psid

Possible causes:

a. Regulator fails open or shifts set point

b. PGA pressure gage fails

PROCEDURE


EMERGENCY PROCEDURE
②
1 High O_2 flow flag "O" (after 5 sec)
YES
NO
2 ● Actuate OPS
3 PLSS O_2 PRESS. REGUL. FAILED OPEN OR SHIFTED SET POINT
EVA PROCEDURE
4 Does GT8168P/GT8268P PGA Press. agree with PGA Press. Gage
YES
NO
5 SHIFT IN PLSS O_2 REGULATED PRESSURE
POST EVA PROCEDURE
6 ● Connect blue PLSS Gas Connector to OPS Regul. Check-out Stowage Plate
Does OPS gage agree with PGA gage
YES
NO
7 GT8168P/GT8268P PGA PRESS. FAILED
8 PGA PRESS. GAGE FAILED

REMARKS

①

PLSS O_2 pressure regulator regulates to 4.0 psid maximum to PGA.

PGA pressure relief valve cracks at 4.5 to 5.5 psid.

②

The PLSS O_2 shutoff valve should be closed if possible. If additional mobility is needed, open purge valve to reduce PGA pressure to >3.4 psid.

SYMPTOM	PROCEDURE	REMARKS

EMU 9

Loss of pump noise

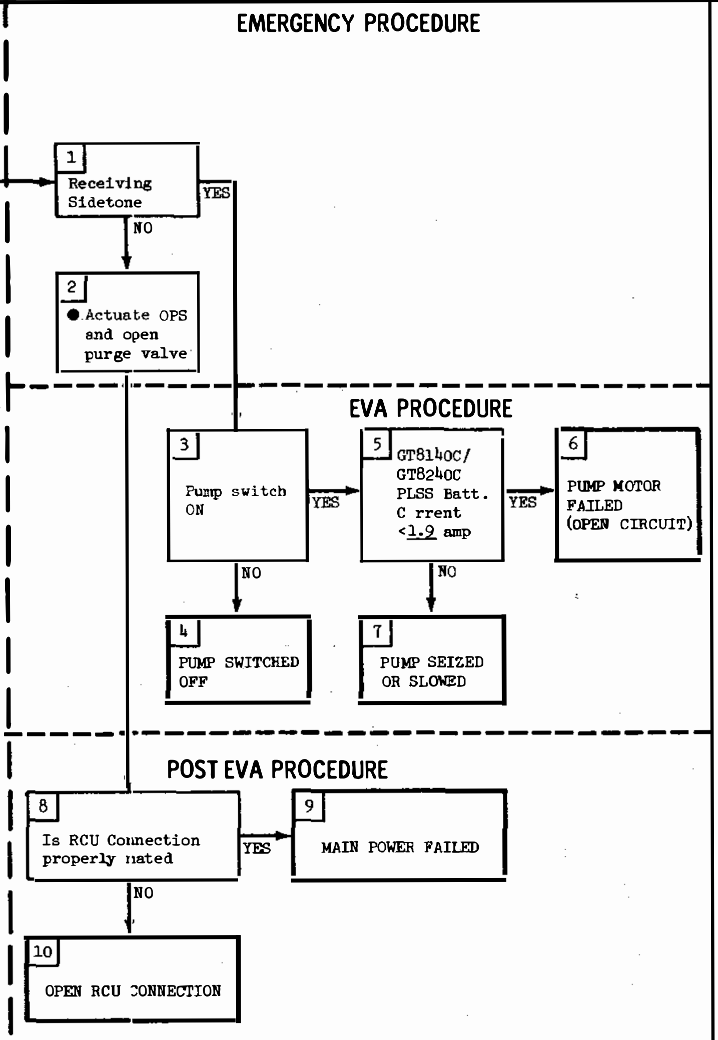
Possible causes:

a. Pump switch OFF

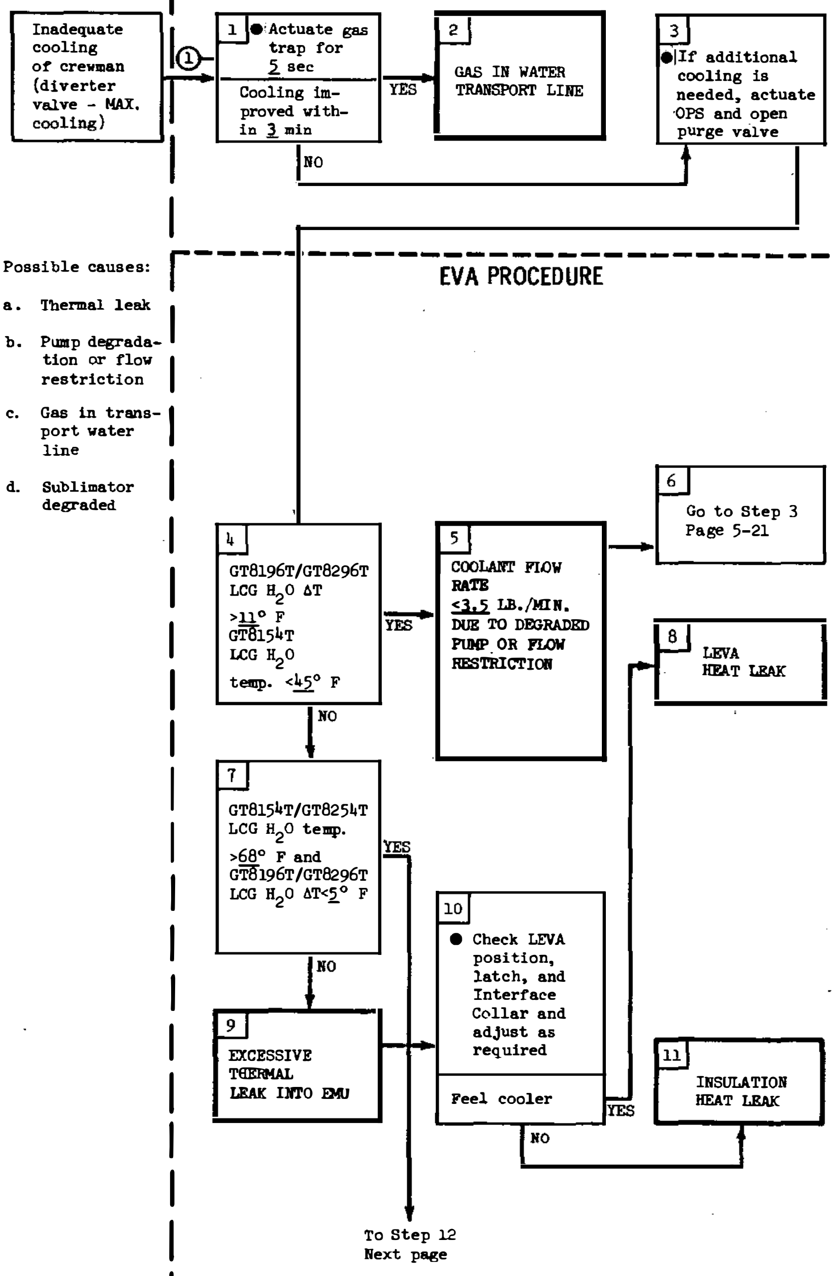
b. Power failure

c. Open RCU connection

d. Pump failure



SYMPTOM	PROCEDURE	REMARKS
EMU 10	**EMERGENCY PROCEDURE**	① Actuation of the gas trap must be performed by another EV crewman. It cannot be self-accomplished.


Inadequate cooling of crewman (diverter valve - MAX. cooling)
①
1 ● Actuate gas trap for 5 sec
Cooling improved within 3 min
YES
NO
2 GAS IN WATER TRANSPORT LINE
3 ● If additional cooling is needed, actuate OPS and open purge valve
EVA PROCEDURE
4 GT8196T/GT8296T LCG H_2O ΔT >11° F GT8154T LCG H_2O temp. <45° F
YES
NO
5 COOLANT FLOW RATE ≤3.5 LB./MIN. DUE TO DEGRADED PUMP OR FLOW RESTRICTION
6 Go to Step 3 Page 5-21
8 LEVA HEAT LEAK
7 GT8154T/GT8254T LCG H_2O temp. >68° F and GT8196T/GT8296T LCG H_2O ΔT<5° F
YES
NO
9 EXCESSIVE THERMAL LEAK INTO EMU
10 ● Check LEVA position, latch, and Interface Collar and adjust as required
Feel cooler
YES
NO
11 INSULATION HEAT LEAK
To Step 12 Next page

Possible causes:

a. Thermal leak

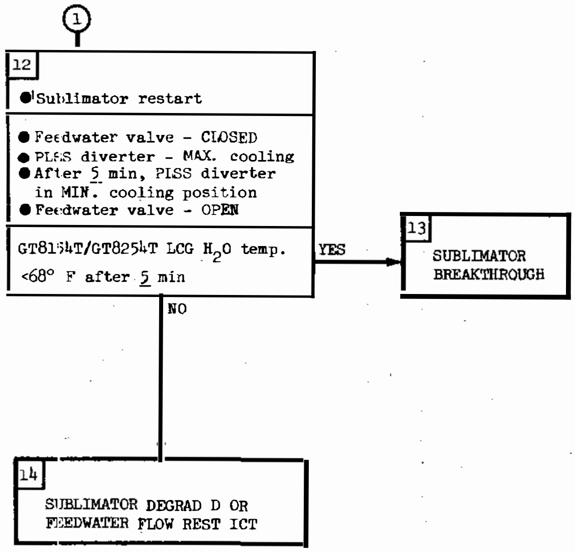
b. Pump degradation or flow restriction

c. Gas in transport water line

d. Sublimator degraded

SYMPTOM	PROCEDURE	REMARKS

EVA PROCEDURE (continued)


①
12
● Sublimator restart
● Feedwater valve - CLOSED
● PLSS diverter - MAX. cooling
● After 5 min, PLSS diverter in MIN. cooling position
● Feedwater valve - OPEN
GT8154T/GT8254T LCG H_2O temp. <68° F after 5 min
YES
NO
13
SUBLIMATOR BREAKTHROUGH
14
SUBLIMATOR DEGRADED OR FEEDWATER FLOW RESTRICT

①

The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.

SYMPTOM	PROCEDURE	REMARKS

EMU 11

EVA PROCEDURE

EVA-1 loses voice from MSFN (see "Additional conditions" below)

Additional conditions:

1. Dual EVA
2. EVA-1 has voice from EVA-2

Possible causes:

a. LM or MSFN failed

b. EVA-1 "A" volume control turned too low

c. EVA-1 R/T Relay K-1 failed closed in backup mode

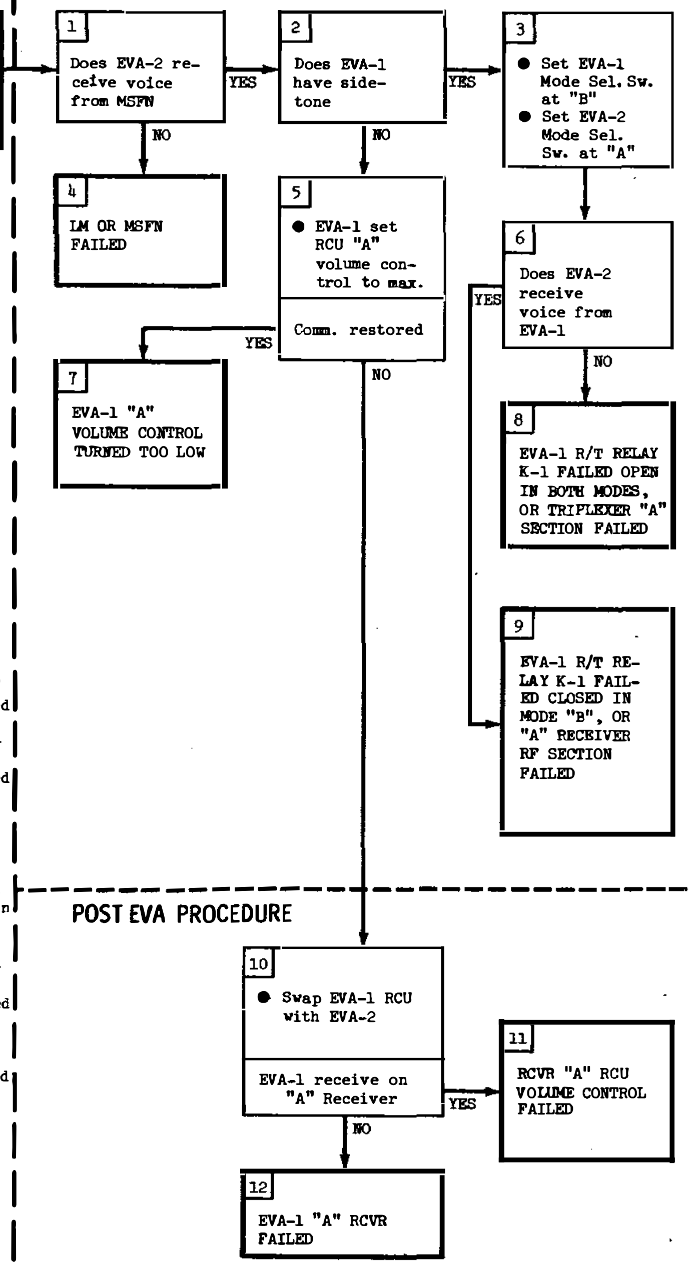
d. Triplexer "A" section failed

e. EVA-1 "A" Receiver RF section failed

f. EVA-1 Triplexer "A" section, "A" Receiver, or R/T Relay K-1 failed open in both modes

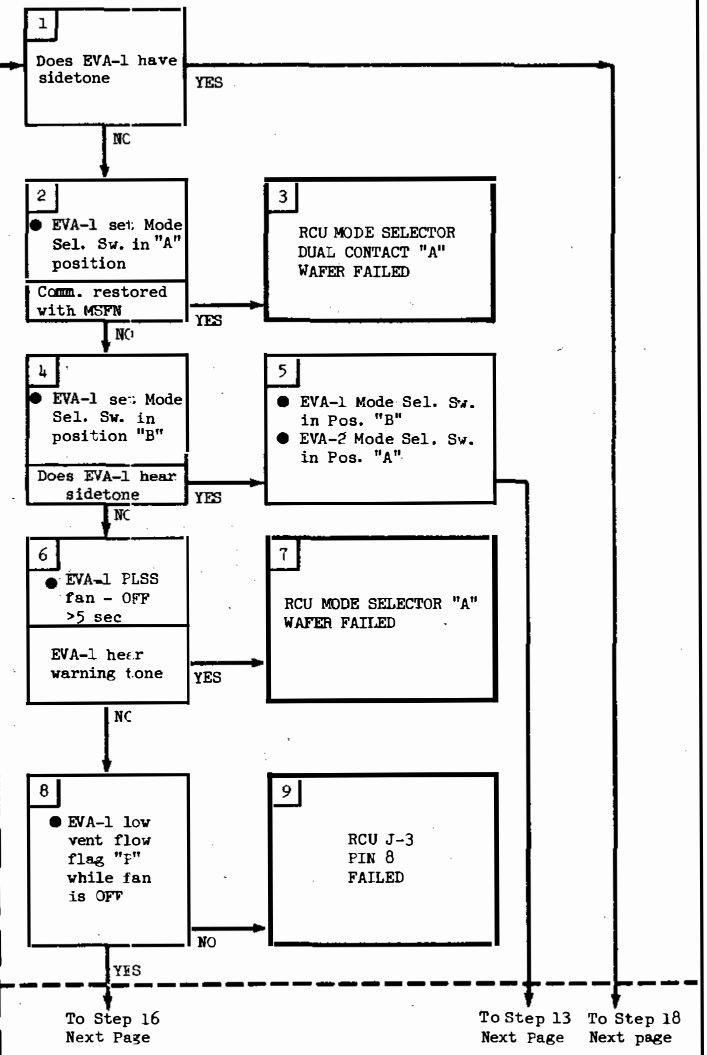
g. EVA-1 "A" Receiver audio section failed

h. Receiver "A" RCU volume control failed


1
Does EVA-2 receive voice from MSFN
YES
2
Does EVA-1 have sidetone
YES
3
● Set EVA-1 Mode Sel. Sw. at "B"
● Set EVA-2 Mode Sel. Sw. at "A"
NO
4
LM OR MSFN FAILED
NO
5
● EVA-1 set RCU "A" volume control to max.
Comm. restored
YES
7
EVA-1 "A" VOLUME CONTROL TURNED TOO LOW
NO
6
Does EVA-2 receive voice from EVA-1
YES
NO
8
EVA-1 R/T RELAY K-1 FAILED OPEN IN BOTH MODES, OR TRIPLEXER "A" SECTION FAILED
9
EVA-1 R/T RELAY K-1 FAILED CLOSED IN MODE "B", OR "A" RECEIVER RF SECTION FAILED
POST EVA PROCEDURE
10
● Swap EVA-1 RCU with EVA-2
EVA-1 receive on "A" Receiver
YES
11
RCVR "A" RCU VOLUME CONTROL FAILED
NO
12
EVA-1 "A" RCVR FAILED

SYMPTOM	PROCEDURE	REMARKS
EMU 12	**EVA PROCEDURE**	

EVA-1 loses voice from MSFN (see "Additional conditions" below)


1
Does EVA-1 have sidetone
YES
NO
2
● EVA-1 set Mode Sel. Sw. in "A" position
Comm. restored with MSFN
YES
NO
3
RCU MODE SELECTOR DUAL CONTACT "A" WAFER FAILED
4
● EVA-1 set Mode Sel. Sw. in position "B"
Does EVA-1 hear sidetone
YES
NO
5
● EVA-1 Mode Sel. Sw. in Pos. "B"
● EVA-2 Mode Sel. Sw. in Pos. "A"
6
● EVA-1 PLSS fan - OFF >5 sec
EVA-1 hear warning tone
YES
NO
7
RCU MODE SELECTOR "A" WAFER FAILED
8
● EVA-1 low vent flow flag "P" while fan is OFF
NO
YES
9
RCU J-3 PIN 8 FAILED
To Step 16 Next Page
To Step 13 Next Page
To Step 18 Next page

Additional conditions:

1. Dual EVA
2. EVA-1 does not receive voice from EVA-2

Possible causes:

a. Comm. carrier failed

b. RCU mode selector "A" section failed

c. RCU cable failed

d. Primary dual comm. regulator failed

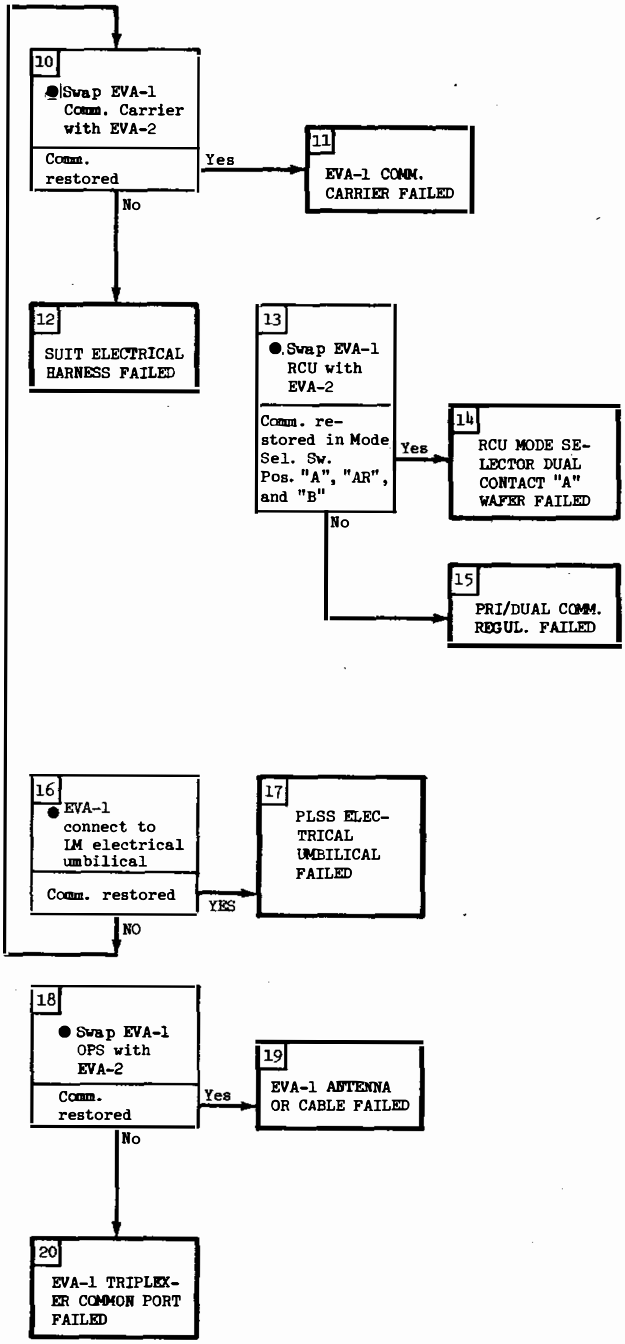
e. PLSS electrical umbilical failed

f. Antenna or triplexer common port failed

g. J-3 Pin 8 failed

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE


10
● Swap EVA-1 Comm. Carrier with EVA-2
Comm. restored
Yes
No
11
EVA-1 COMM. CARRIER FAILED
12
SUIT ELECTRICAL HARNESS FAILED
13
● Swap EVA-1 RCU with EVA-2
Comm. re-stored in Mode Sel. Sw. Pos. "A", "AR", and "B"
Yes
No
14
RCU MODE SELECTOR DUAL CONTACT "A" WAFER FAILED
15
PRI/DUAL COMM. REGUL. FAILED
16
● EVA-1 connect to LM electrical umbilical
Comm. restored
YES
NO
17
PLSS ELECTRICAL UMBILICAL FAILED
18
● Swap EVA-1 OPS with EVA-2
Comm. restored
Yes
No
19
EVA-1 ANTENNA OR CABLE FAILED
20
EVA-1 TRIPLEXER COMMON PORT FAILED

SYMPTOM	PROCEDURE	REMARKS
EMU 13	EVA PROCEDURE	

EVA-1 loses voice from EVA-2 (See "Additional conditions" below)

Additional conditions:

1. EVA-1 has voice from MSFM
2. Dual EVA

Possible causes:

a. EVA-1 B/C volume control set too low

b. EVA-1 "B" receiver audio section failed

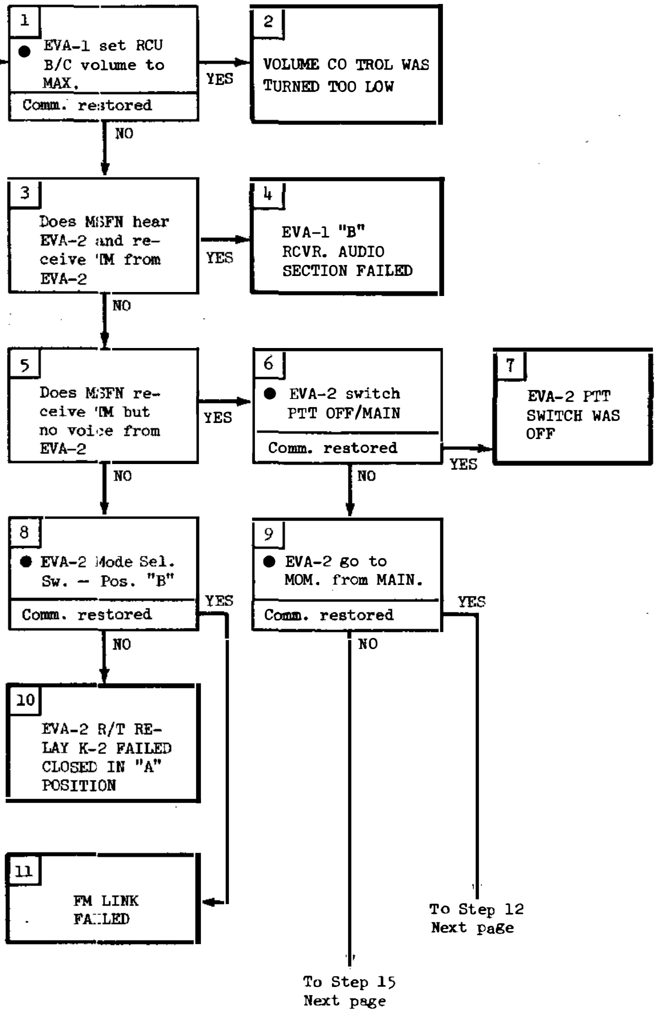
c. EVA-2 PTT switch was OFF

d. EVA-2 R/T Relay K-2 failed closed in "A" position

e. FM link failed

f. Audio section of signal processor failed

(continued on next page)


1
● EVA-1 set RCU B/C volume to MAX.
Comm. restored
YES
2
VOLUME CONTROL WAS TURNED TOO LOW
NO
3
Does MSFN hear EVA-2 and receive TM from EVA-2
YES
4
EVA-1 "B" RCVR. AUDIO SECTION FAILED
NO
5
Does MSFN receive TM but no voice from EVA-2
YES
6
● EVA-2 switch PTT OFF/MAIN
Comm. restored
YES
7
EVA-2 PTT SWITCH WAS OFF
NO
NO
8
● EVA-2 Mode Sel. Sw. – Pos. "B"
Comm. restored
YES
9
● EVA-2 go to MOM. from MAIN.
Comm. restored
YES
NO
NO
10
EVA-2 R/T RELAY K-2 FAILED CLOSED IN "A" POSITION
11
FM LINK FAILED
To Step 15 Next page
To Step 12 Next page

SYMPTOM	PROCEDURE	REMARKS

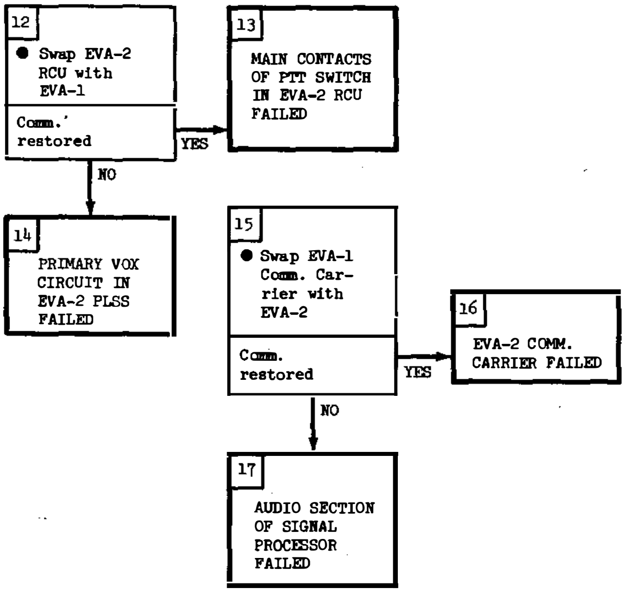
POST EVA PROCEDURE

Possible causes:
(continued)

g. PTT circuit in EVA-2 RCU failed

h. PTT circuit in EVA-2 PLSS failed

i. EVA-2 comm. carrier failed


12
● Swap EVA-2 RCU with EVA-1
Comm. restored
YES
NO
13
MAIN CONTACTS OF PTT SWITCH IN EVA-2 RCU FAILED
14
PRIMARY VOX CIRCUIT IN EVA-2 PLSS FAILED
15
● Swap EVA-1 Comm. Carrier with EVA-2
Comm. restored
YES
NO
16
EVA-2 COMM. CARRIER FAILED
17
AUDIO SECTION OF SIGNAL PROCESSOR FAILED

SYMPTOM	PROCEDURE	REMARKS
EMU 14	EVA PROCEDURE	

EVA-2 loses voice from MSFN (see "Additional conditions" below)

Additional conditions:

1. Dual EVA
2. EVA-2 receives voice from EVA-1

Possible causes:

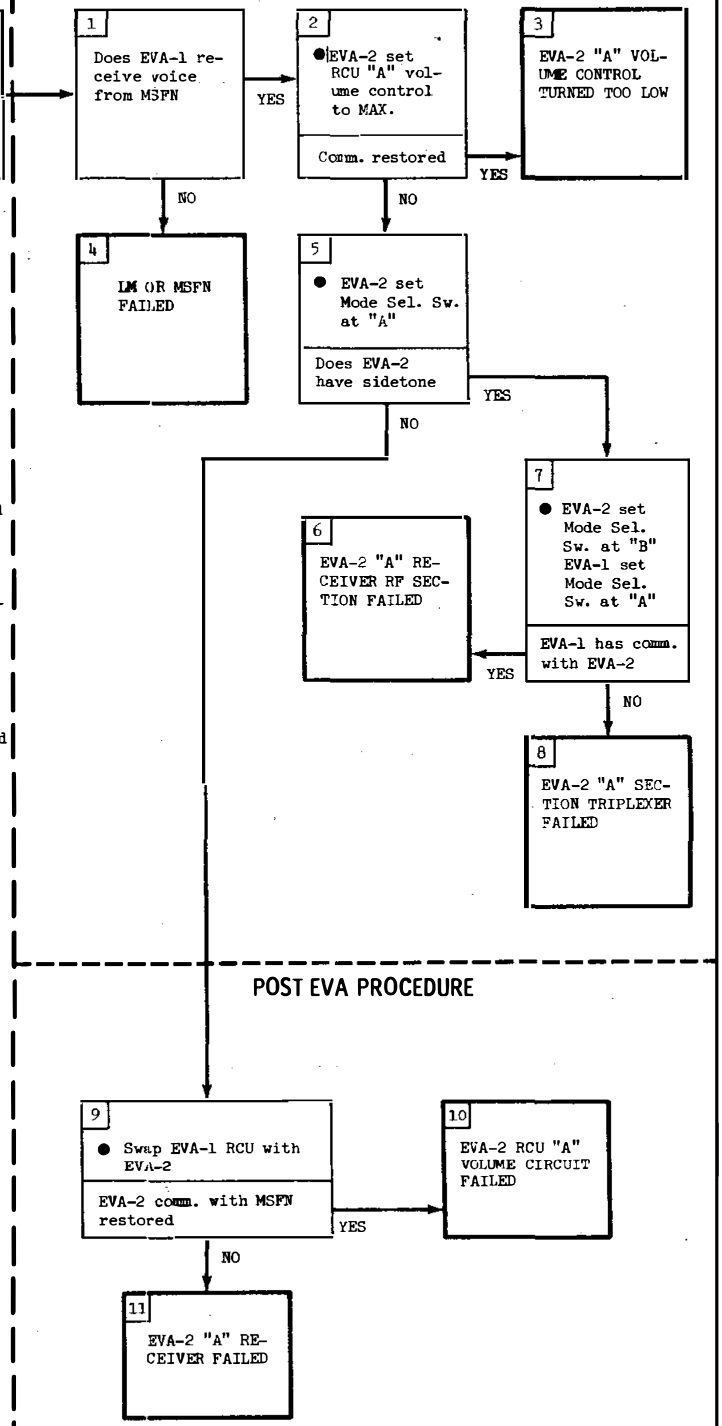
a. "A" volume control turned too low or failed

b. LM or MSFN failed

c. EVA-2 "A" Receiver RF section failed

d. EVA-2 "A" section triplexer failed

e. EVA-2 "A" receiver failed


1
Does EVA-1 receive voice from MSFN
YES
NO
2
● EVA-2 set RCU "A" volume control to MAX.
Comm. restored
YES
NO
3
EVA-2 "A" VOLUME CONTROL TURNED TOO LOW
4
LM OR MSFN FAILED
5
● EVA-2 set Mode Sel. Sw. at "A"
Does EVA-2 have sidetone
YES
NO
6
EVA-2 "A" RECEIVER RF SECTION FAILED
7
● EVA-2 set Mode Sel. Sw. at "B" EVA-1 set Mode Sel. Sw. at "A"
EVA-1 has comm. with EVA-2
YES
NO
8
EVA-2 "A" SECTION TRIPLEXER FAILED
POST EVA PROCEDURE
9
● Swap EVA-1 RCU with EVA-2
EVA-2 comm. with MSFN restored
YES
NO
10
EVA-2 RCU "A" VOLUME CIRCUIT FAILED
11
EVA-2 "A" RECEIVER FAILED

SYMPTOM	PROCEDURE	REMARKS
EMU 15	**EVA PROCEDURE**	

EVA-2 loses voice from MSFN (See "Additional conditions" below)

Additional conditions:

1. Dual EVA
2. EVA-2 does not receive voice from EVA-1

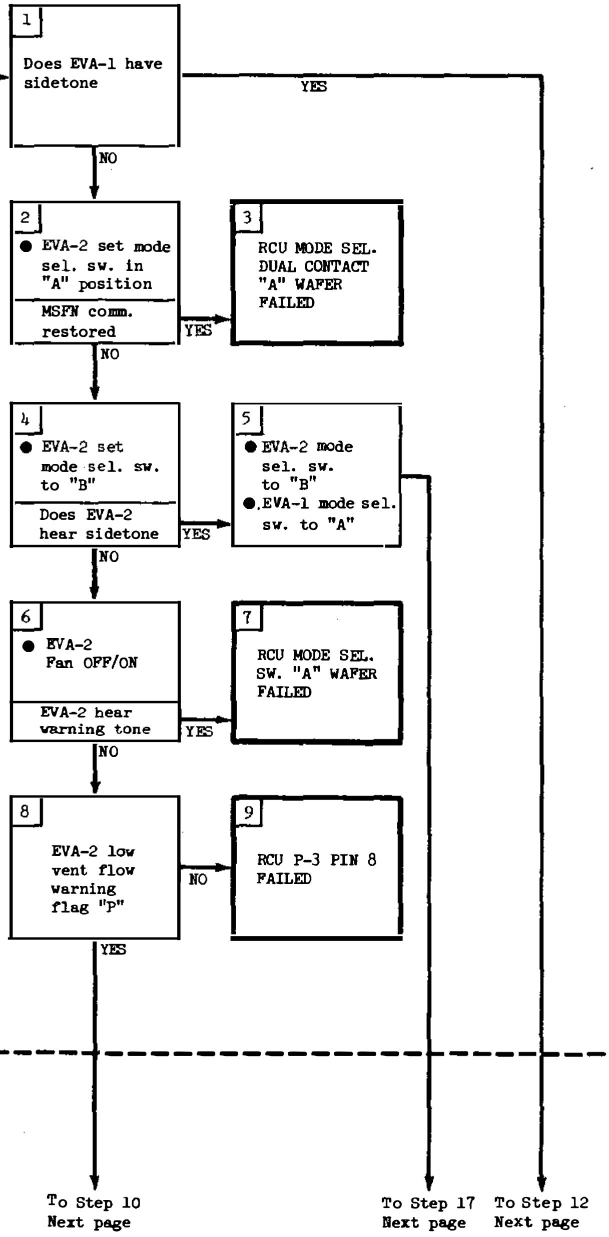
Possible causes:

a. RCU mode selector dual contact failed

b. RCU mode selector switch "A" wafer failed

c. RCU P-3 Pin 8 failed

(continued on next page)


1
Does EVA-1 have sidetone
YES
NO
2
● EVA-2 set mode sel. sw. in "A" position
MSFN comm. restored
YES
NO
3
RCU MODE SEL. DUAL CONTACT "A" WAFER FAILED
4
● EVA-2 set mode sel. sw. to "B"
Does EVA-2 hear sidetone
YES
NO
5
● EVA-2 mode sel. sw. to "B"
● EVA-1 mode sel. sw. to "A"
6
● EVA-2 Fan OFF/ON
EVA-2 hear warning tone
YES
NO
7
RCU MODE SEL. SW. "A" WAFER FAILED
8
EVA-2 low vent flow warning flag "P"
NO
YES
9
RCU P-3 PIN 8 FAILED
To Step 10 Next page
To Step 17 Next page
To Step 12 Next page

SYMPTOM	PROCEDURE	REMARKS
EMU 15	**POST EVA PROCEDURE**	

d. PLSS electrical umbilical failed

e. EVA-2 comm. carrier failed

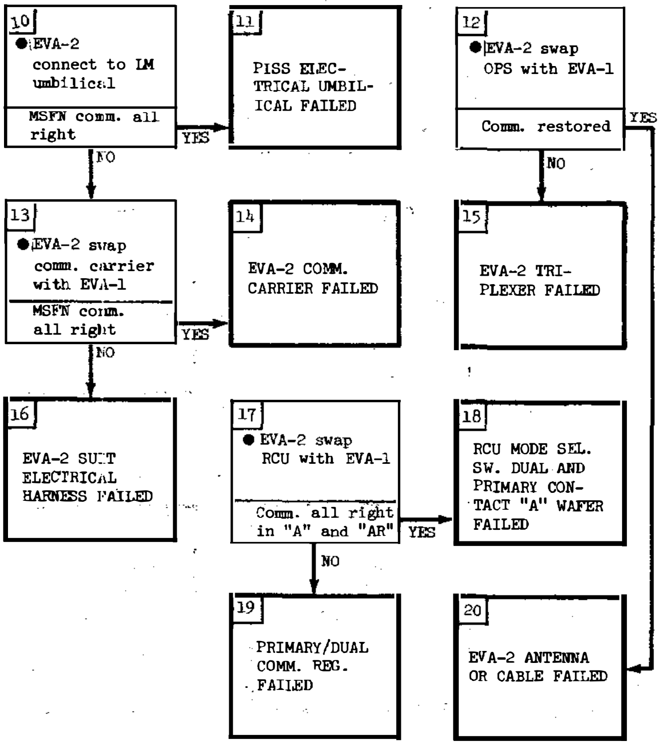
f. EVA-2 triplexer failed

g. EVA-2 suit electrical harness failed

h. RCU mode selector switch dual and primary contact "A" wafer failed

i. Primary/dual comm. regulator failed

j. EVA-2 antenna or cable failed


10
● EVA-2 connect to LM umbilical
MSFN comm. all right
YES
NO
11
PLSS ELECTRICAL UMBILICAL FAILED
12
● EVA-2 swap OPS with EVA-1
Comm. restored
YES
NO
13
● EVA-2 swap comm. carrier with EVA-1
MSFN comm. all right
YES
NO
14
EVA-2 COMM. CARRIER FAILED
15
EVA-2 TRIPLEXER FAILED
16
EVA-2 SUIT ELECTRICAL HARNESS FAILED
17
● EVA-2 swap RCU with EVA-1
Comm. all right in "A" and "AR"
YES
NO
18
RCU MODE SEL. SW. DUAL AND PRIMARY CONTACT "A" WAFER FAILED
19
PRIMARY/DUAL COMM. REG. FAILED
20
EVA-2 ANTENNA OR CABLE FAILED

SYMPTOM | **PROCEDURE** | **REMARKS**

EMU 16

EVA PROCEDURE

EVA-2 loses voice from EVA-1 (See "Additional conditions" below)

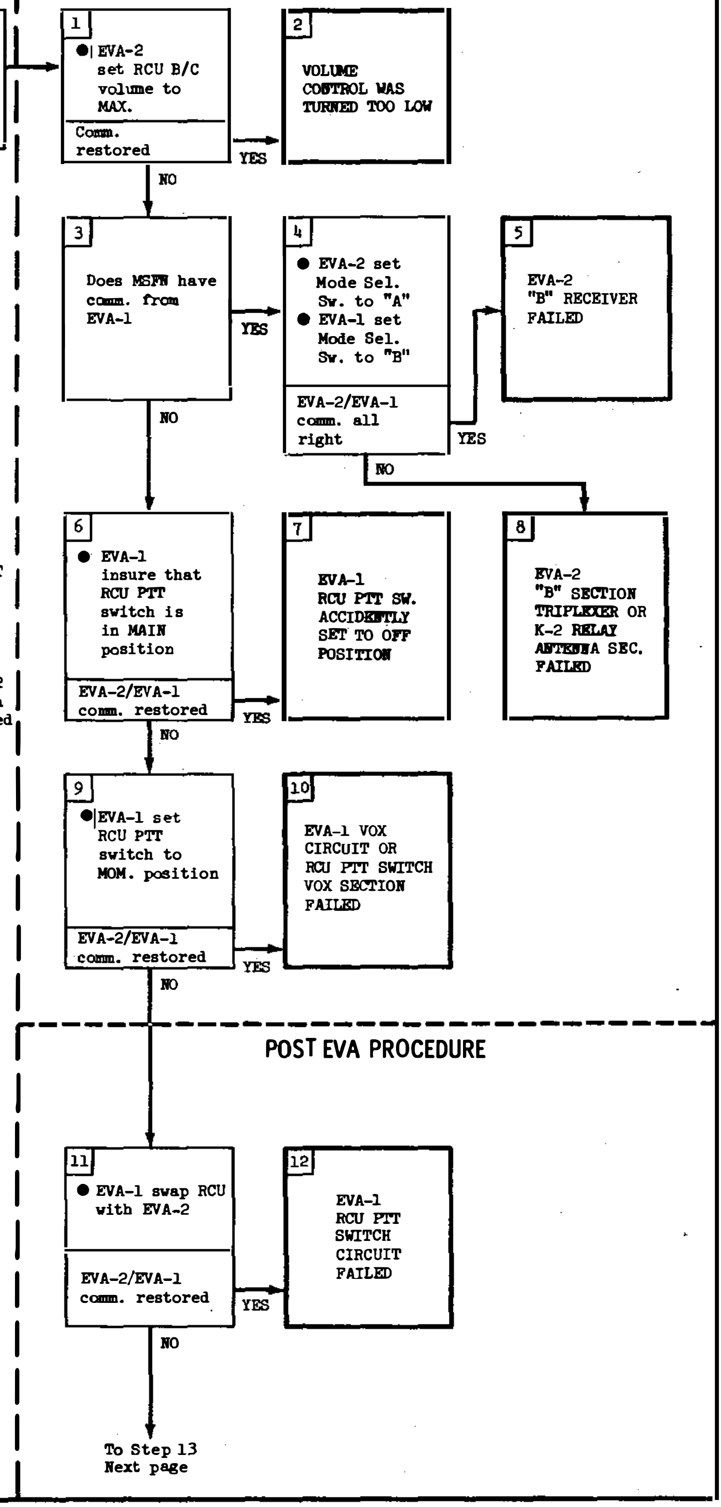
Additional conditions:

1. Dual EVA
2. EVA-2 has comm. with MSFN

Possible causes:

a. EVA-2 B/C volume control turned too low
b. EVA-2 "B" receiver failed
c. EVA-1 RCU PTT switch turned OFF
d. EVA-2 "B" section triplexer or K-2 relay antenna section failed

(Continued next page)

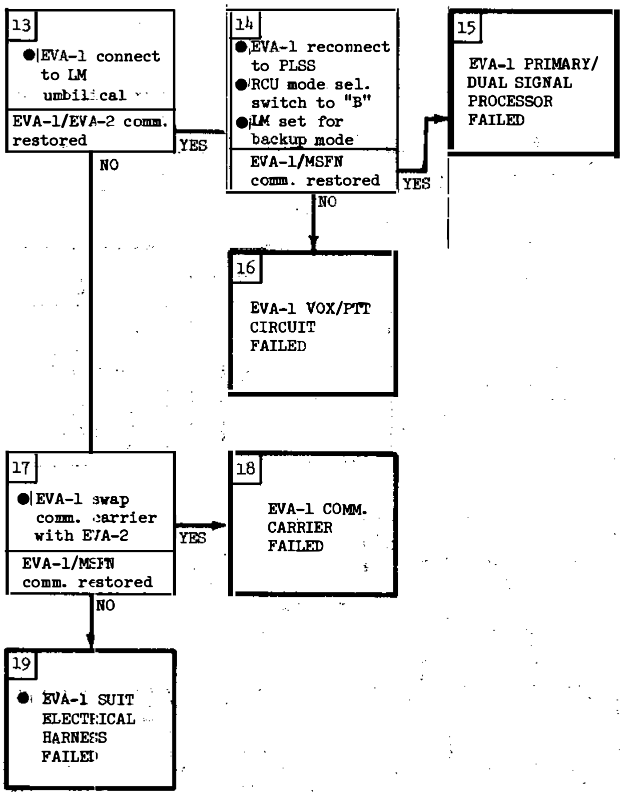

1
● EVA-2 set RCU B/C volume to MAX.
Comm. restored
YES
2
VOLUME CONTROL WAS TURNED TOO LOW
NO
3
Does MSFN have comm. from EVA-1
YES
4
● EVA-2 set Mode Sel. Sw. to "A"
● EVA-1 set Mode Sel. Sw. to "B"
EVA-2/EVA-1 comm. all right
YES
5
EVA-2 "B" RECEIVER FAILED
NO
NO
6
● EVA-1 insure that RCU PTT switch is in MAIN position
EVA-2/EVA-1 comm. restored
YES
7
EVA-1 RCU PTT SW. ACCIDENTLY SET TO OFF POSITION
8
EVA-2 "B" SECTION TRIPLEXER OR K-2 RELAY ANTENNA SEC. FAILED
NO
9
● EVA-1 set RCU PTT switch to MOM. position
EVA-2/EVA-1 comm. restored
YES
10
EVA-1 VOX CIRCUIT OR RCU PTT SWITCH VOX SECTION FAILED
NO
POST EVA PROCEDURE
11
● EVA-1 swap RCU with EVA-2
EVA-2/EVA-1 comm. restored
YES
12
EVA-1 RCU PTT SWITCH CIRCUIT FAILED
NO
To Step 13 Next page

SYMPTOM | PROCEDURE | REMARKS

POST EVA PROCEDURE (continued)

Possible causes: (continued)

- e. EVA-1 VOX circuit or RCU PTT switch VOX section failed
- f. EVA-1 RCU PTT switch circuit failed
- g. EVA-1 primary/dual signal processor failed
- h. EVA-1 VOX/PTT circuit failed
- i. EVA-1 comm. carrier failed
- j. EVA-1 suit electrical harness failed


13
● EVA-1 connect to LM umbilical
EVA-1/EVA-2 comm. restored
YES
NO
14
● EVA-1 reconnect to PLSS
● RCU mode sel. switch to "B"
● LM set for backup mode
EVA-1/MSFN comm. restored
YES
NO
15
EVA-1 PRIMARY/ DUAL SIGNAL PROCESSOR FAILED
16
EVA-1 VOX/PTT CIRCUIT FAILED
17
● EVA-1 swap comm. carrier with EVA-2
EVA-1/MSFN comm. restored
YES
NO
18
EVA-1 COMM. CARRIER FAILED
19
● EVA-1 SUIT ELECTRICAL HARNESS FAILED

SYMPTOM	PROCEDURE	REMARKS

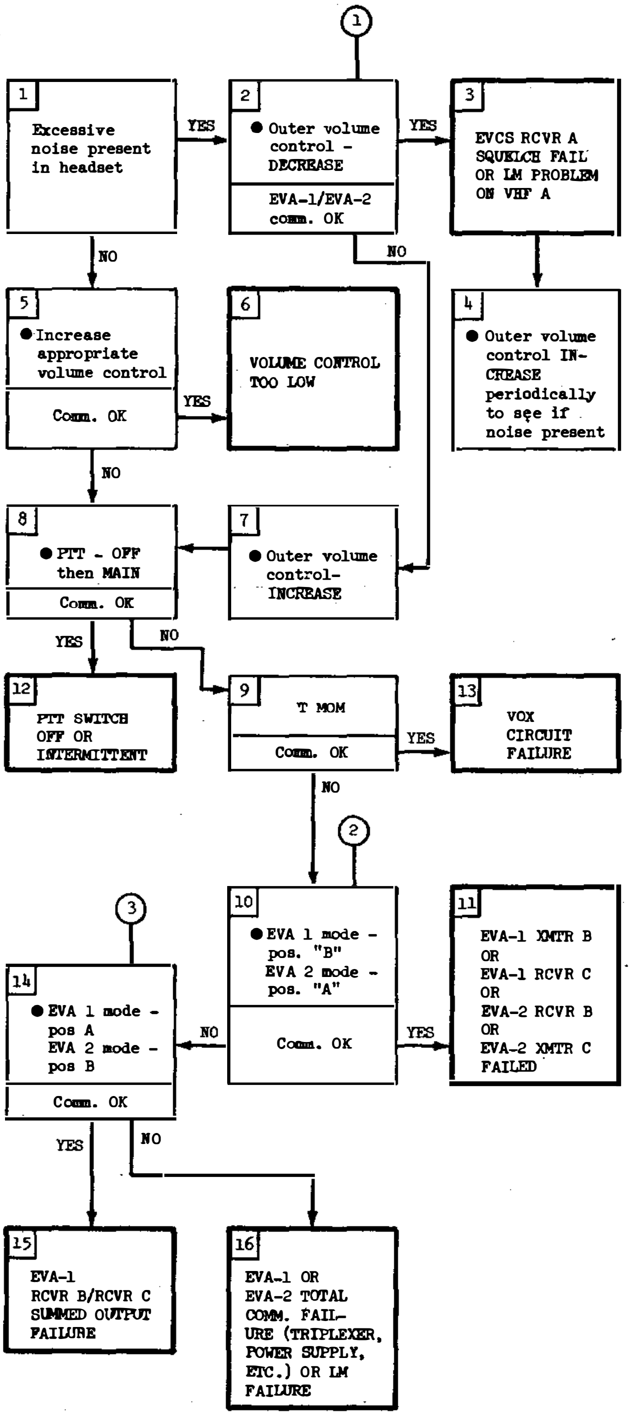
EMU 17

Loss of voice comm. with EVA-1, EVA-2, or MSFN (two-man EVA) (comm. restoration procedure)

Possible causes:

- a. EVCS receiver "A" squelch failure
- b. LM VHF "A" failure
- c. Volume control to low
- d. PTT switch OFF or intermittent
- e. VOX circuit failure
- f. EVA-1 XMTR "B", EVA-1 RCVR "C", EVA-2 RCVR "B", or EVA-2 XMTR "C" failed.
- g. EVA-1 RCVR "B"/RCVR "C" summed output failure
- h. EVA-1 or EVA-2 total comm. failure

EVA PROCEDURE


①
1 Excessive noise present in headset
YES
2 ● Outer volume control - DECREASE
EVA-1/EVA-2 comm. OK
YES
3 EVCS RCVR A SQUELCH FAIL OR LM PROBLEM ON VHF A
NO
NO
5 ● Increase appropriate volume control
Comm. OK
YES
6 VOLUME CONTROL TOO LOW
4 ● Outer volume control INCREASE periodically to see if noise present
NO
8 ● PTT - OFF then MAIN
Comm. OK
7 ● Outer volume control- INCREASE
YES
NO
12 PTT SWITCH OFF OR INTERMITTENT
9 T MOM
Comm. OK
YES
13 VOX CIRCUIT FAILURE
NO
②
③
10 ● EVA 1 mode - pos. "B" EVA 2 mode - pos. "A"
Comm. OK
YES
11 EVA-1 XMTR B OR EVA-1 RCVR C OR EVA-2 RCVR B OR EVA-2 XMTR C FAILED
NO
14 ● EVA 1 mode - pos A EVA 2 mode - pos B
Comm. OK
YES
NO
15 EVA-1 RCVR B/RCVR C SUMMED OUTPUT FAILURE
16 EVA-1 OR EVA-2 TOTAL COMM. FAILURE (TRIPLEXER, POWER SUPPLY, ETC.) OR LM FAILURE

①

Reception of MSFN is disabled while outer volume is in full DECREASE.

②

EMU data not available from EVA-1. EVA-1 cannot hear MSFN.

③

EMU data not available from EVA-2. EVA-2 cannot hear MSFN.

SYMPTOM	PROCEDURE	REMARKS

EMU 18

EVA loses voice from LM (see "Additional conditions" below)

Additional conditions:

1. Single EVA

Possible causes:

a. EVA "A" volume control turned too low

b. EVA "A" receiver RF section failed

c. R/T Relay K-1 failed

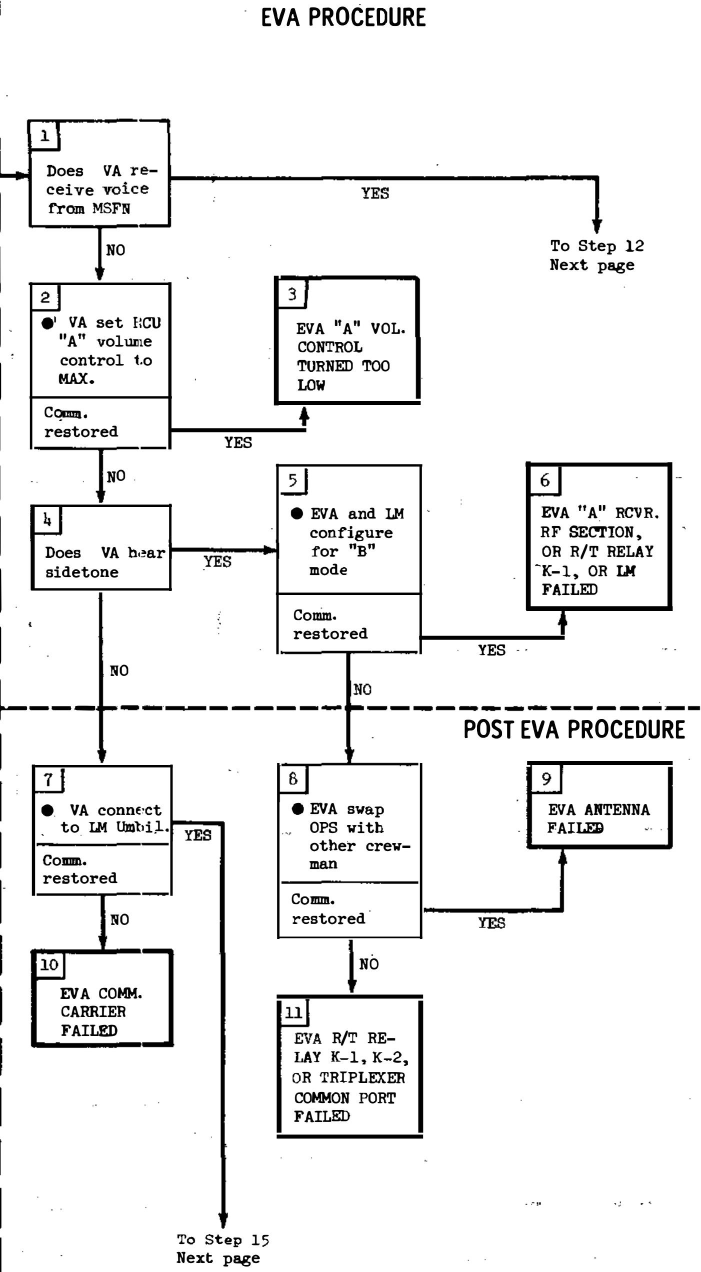
d. EVA antenna failed

e. EVA comm. carrier failed

f. Triplexer common port failed

g. LM electrical umbilical failed

(Continued next page)


EVA PROCEDURE
1 Does VA receive voice from MSFN
YES
To Step 12 Next page
NO
2 ● VA set RCU "A" volume control to MAX.
Comm. restored
YES
3 EVA "A" VOL. CONTROL TURNED TOO LOW
NO
4 Does VA hear sidetone
YES
5 ● EVA and LM configure for "B" mode
Comm. restored
YES
6 EVA "A" RCVR. RF SECTION, OR R/T RELAY K-1, OR LM FAILED
NO
NO
POST EVA PROCEDURE
7 ● VA connect to LM Umbil.
Comm. restored
YES
To Step 15 Next page
NO
10 EVA COMM. CARRIER FAILED
8 ● EVA swap OPS with other crewman
Comm. restored
YES
9 EVA ANTENNA FAILED
NO
11 EVA R/T RELAY K-1, K-2, OR TRIPLEXER COMMON PORT FAILED

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE (continued)

Possible causes:
(continued from preceding page)

h. EVA RCU "A" volume circuit failed

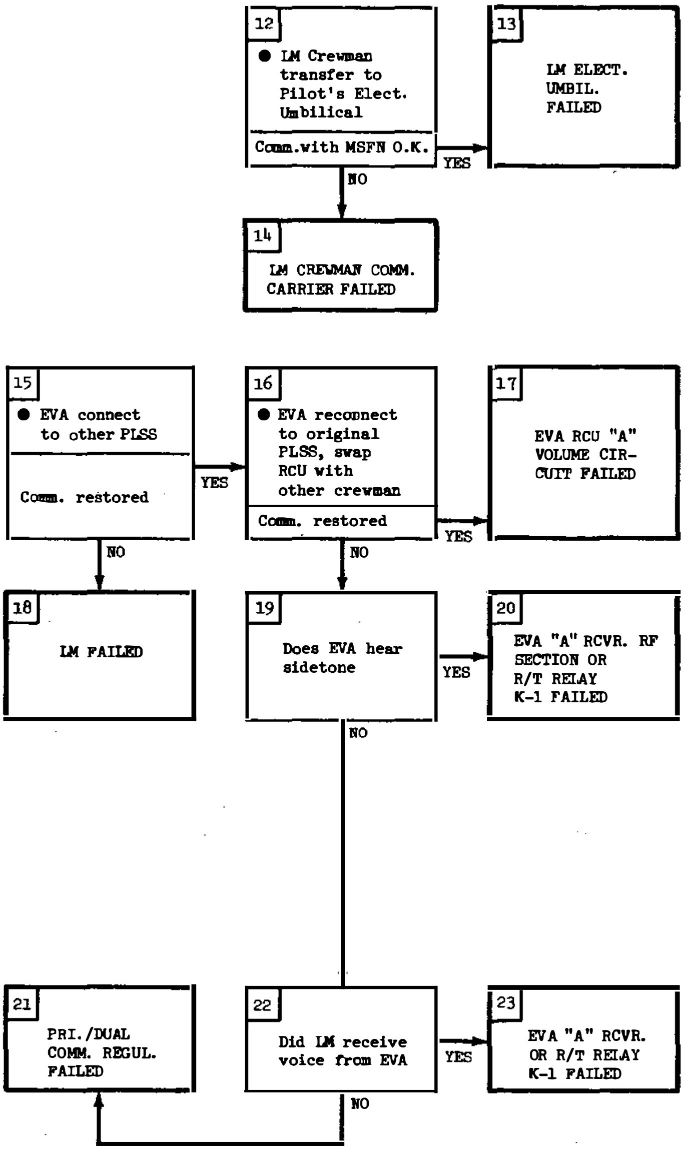
i. LM failed

j. EVA "A" receiver RF section failed

k. PLSS electrical umbilical failed

l. Primary dual comm. regulator failed

m. EVA "A" receiver failed


12
● LM Crewman transfer to Pilot's Elect. Umbilical
Comm. with MSFN O.K.
YES
NO
13
LM ELECT. UMBIL. FAILED
14
LM CREWMAN COMM. CARRIER FAILED
15
● EVA connect to other PLSS
Comm. restored
YES
NO
16
● EVA reconnect to original PLSS, swap RCU with other crewman
Comm. restored
YES
NO
17
EVA RCU "A" VOLUME CIRCUIT FAILED
18
LM FAILED
19
Does EVA hear sidetone
YES
NO
20
EVA "A" RCVR. RF SECTION OR R/T RELAY K-1 FAILED
21
PRI./DUAL COMM. REGUL. FAILED
22
Did LM receive voice from EVA
YES
NO
23
EVA "A" RCVR. OR R/T RELAY K-1 FAILED

SYMPTOM | **PROCEDURE** | **REMARKS**

EMU 19

EVA PROCEDURE

LM loses voice from EVA (see "Additional conditions" below)

Additional conditions:

1. Single EVA

Possible causes:

a. LM failed

b. EVA RCU PTT switch turned OFF

c. EVA VOX circuit failed

d. EVA "A" mode failed

e. EVA comm. carrier failed

f. EVA RCU VOX circuit failed

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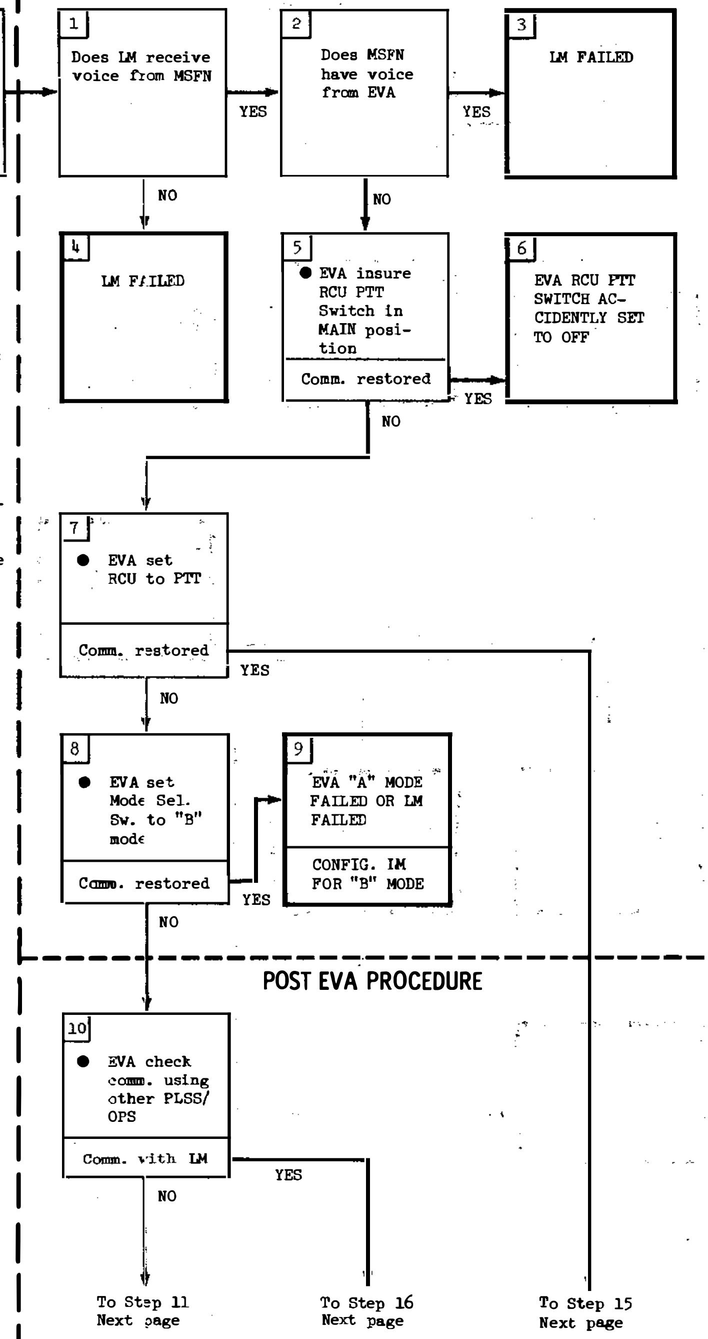

1
Does LM receive voice from MSFN
YES
2
Does MSFN have voice from EVA
YES
3
LM FAILED
NO
4
LM FAILED
NO
5
● EVA insure RCU PTT Switch in MAIN position
Comm. restored
YES
6
EVA RCU PTT SWITCH ACCIDENTLY SET TO OFF
NO
7
● EVA set RCU to PTT
Comm. restored
YES
NO
8
● EVA set Mode Sel. Sw. to "B" mode
Comm. restored
YES
9
EVA "A" MODE FAILED OR LM FAILED
CONFIG. LM FOR "B" MODE
NO
POST EVA PROCEDURE
10
● EVA check comm. using other PLSS/OPS
Comm. with LM
YES
NO
To Step 11 Next page
To Step 16 Next page
To Step 15 Next page

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE (continued)

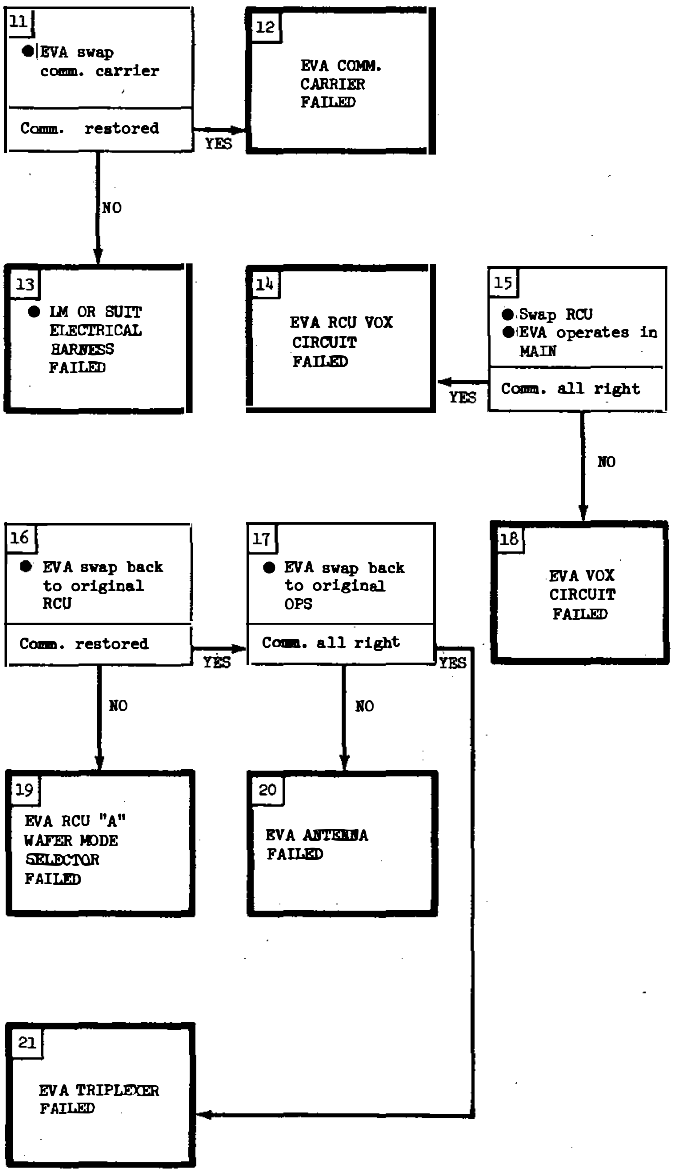
Possible causes:
(Continued from preceding page)

g. EVA RCU mode select "A" wafer failed

h. EVA antenna failed

i. EVA triplexer common port failed

j. Suit electrical harness failed



SYMPTOM

EMU 20

① GT8168P/ GT8268P PGA pressure <3.7 psid and apparently stable (no warning tone)

Possible causes:

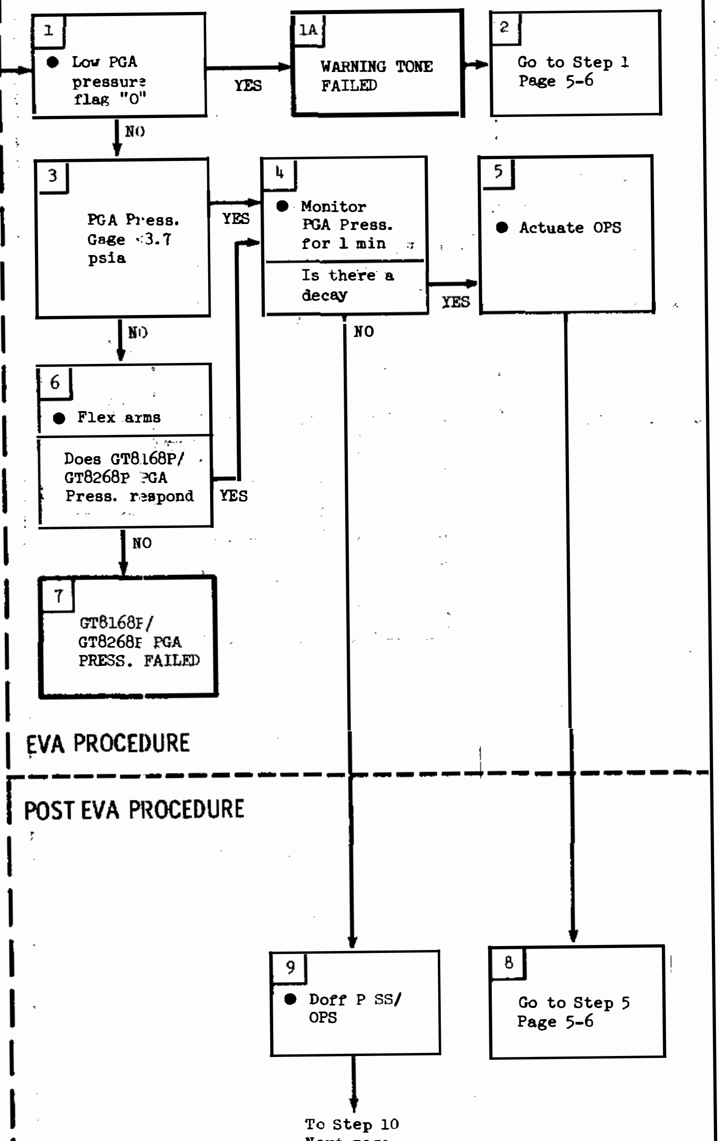
a. GT8168P/ GT8268P failed

b. PLSS O_2 regulator shift/degraded

c. EMU leak

PROCEDURE

EMERGENCY PROCEDURE

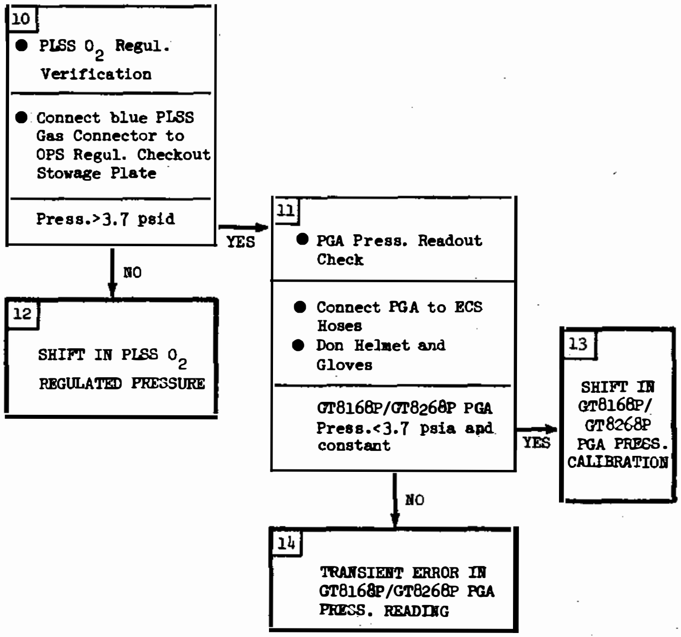


REMARKS

① PLSS O_2 pressure regulator regulates the PGA to 3.7 psid minimum if flow is 0.07 to 0.7 lb/hr.

SYMPTOM	PROCEDURE	REMARKS

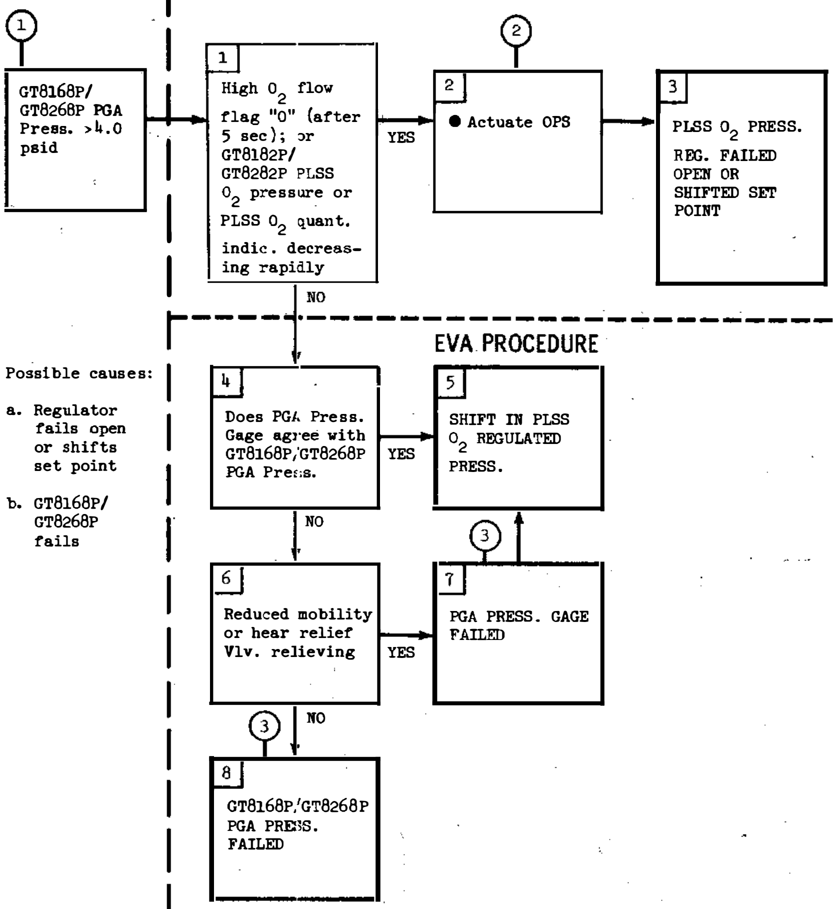
POST EVA PROCEDURE (continued)


10
● PLSS O_2 Regul. Verification
● Connect blue PLSS Gas Connector to OPS Regul. Checkout Stowage Plate
Press.>3.7 psid
YES
NO
11
● PGA Press. Readout Check
● Connect PGA to ECS Hoses
● Don Helmet and Gloves
GT8168P/GT8268P PGA Press.<3.7 psia and constant
YES
NO
12
SHIFT IN PLSS O_2 REGULATED PRESSURE
13
SHIFT IN GT8168P/ GT8268P PGA PRESS. CALIBRATION
14
TRANSIENT ERROR IN GT8168P/GT8268P PGA PRESS. READING

SYMPTOM	PROCEDURE	REMARKS

EMU 21

EMERGENCY PROCEDURE


①
GT8168P/ GT8268P PGA Press. >4.0 psid
1
High O_2 flow flag "0" (after 5 sec); or GT8182P/ GT8282P PLSS O_2 pressure or PLSS O_2 quant. indic. decreasing rapidly
YES
②
2
● Actuate OPS
3
PLSS O_2 PRESS. REG. FAILED OPEN OR SHIFTED SET POINT
NO
EVA PROCEDURE
4
Does PGA Press. Gage agree with GT8168P/GT8268P PGA Press.
YES
5
SHIFT IN PLSS O_2 REGULATED PRESS.
NO
③
6
Reduced mobility or hear relief Vlv. relieving
YES
7
PGA PRESS. GAGE FAILED
③
NO
8
GT8168P/GT8268P PGA PRESS. FAILED

Possible causes:

a. Regulator fails open or shifts set point

b. GT8168P/ GT8268P fails

① PLSS O_2 pressure regulator regulates to 4.0 psid maximum to PGA. PGA pressure relief valve cracks at 4.5 to 5.5 psid.

② The PLSS O_2 shutoff valve should be CLOSED if possible. If additional mobility is needed, open purge valve to reduce PGA pressure to >3.4 psid.

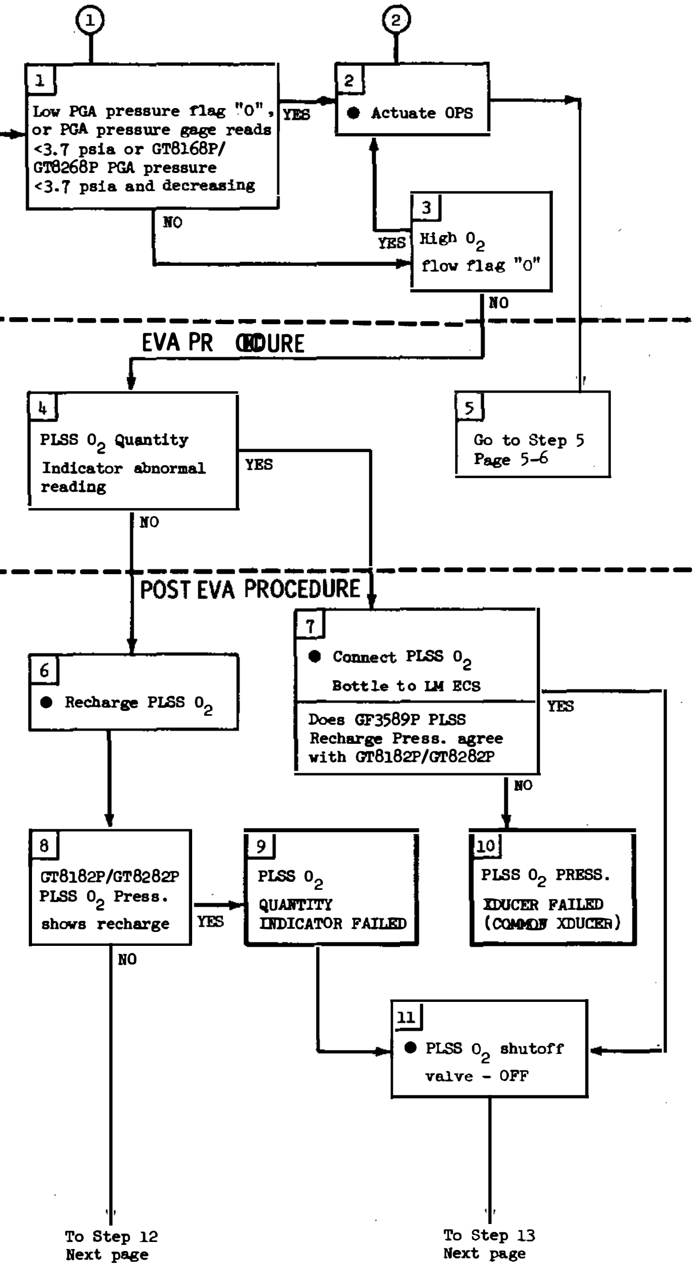
③ Upon returning to the LM, Steps 7 and 8 can be verified by connecting the blue PLSS gas connector to the OPS pressure regulator checkout stowage plate.

SYMPTOM	PROCEDURE	REMARKS

EMU 22

EMERGENCY PROCEDURE

GT8182P/
GT8282P
PLSS O_2
pressure
abnormal


①
②
1
Low PGA pressure flag "O", or PGA pressure gage reads <3.7 psia or GT8168P/GT8268P PGA pressure <3.7 psia and decreasing
YES
NO
2
● Actuate OPS
3
High O_2 flow flag "O"
YES
NO
EVA PROCEDURE
4
PLSS O_2 Quantity Indicator abnormal reading
YES
NO
5
Go to Step 5 Page 5-6
POST EVA PROCEDURE
6
● Recharge PLSS O_2
7
● Connect PLSS O_2 Bottle to LM ECS
Does GF3589P PLSS Recharge Press. agree with GT8182P/GT8282P
YES
NO
8
GT8182P/GT8282P PLSS O_2 Press. shows recharge
YES
NO
9
PLSS O_2 QUANTITY INDICATOR FAILED
10
PLSS O_2 PRESS. XDUCER FAILED (COMMON XDUCER)
11
● PLSS O_2 shutoff valve - OFF
To Step 12 Next page
To Step 13 Next page

Possible causes:

a. GT8182P/ GT8282P failed

b. EMU leak

c. Common PLSS O_2 pressure sensor failed

d. PLSS O_2 pressure regulator out of spec.

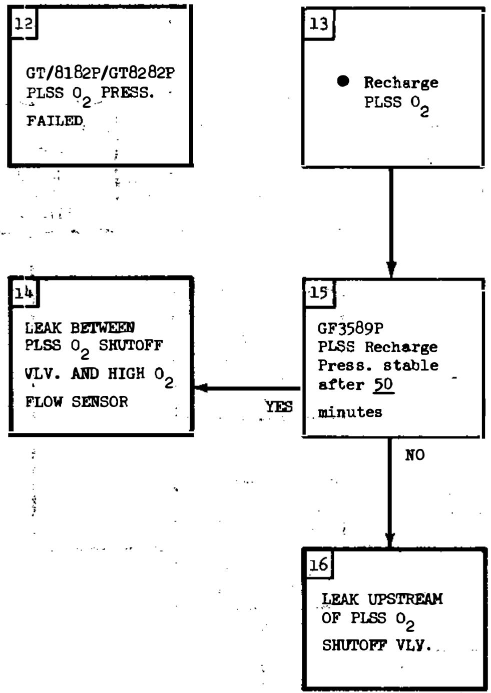
e. High O_2 usage

①

1600 Btu/hr metabolic load plus allowable EMU leakage consumes approximately 0.25 lb/hr O_2. Without makeup O_2, this will reduce PGA pressure to 3 psia in approximately 3 min.

②

OPS regulates at 3.4 to 4.0 psid.

SYMPTOM	PROCEDURE	REMARKS
	POST EVA PROCEDURE (continued) 	

12
GT/8182P/GT8282P PLSS O_2 PRESS. FAILED
13
● Recharge PLSS O_2
14
LEAK BETWEEN PLSS O_2 SHUTOFF VLV. AND HIGH O_2 FLOW SENSOR
15
GF3589P PLSS Recharge Press. stable after 50 minutes
YES
NO
16
LEAK UPSTREAM OF PLSS O_2 SHUTOFF VLV.

SYMPTOM	PROCEDURE	REMARKS
EMU 23	**PRE-EVA PROCEDURE**	

①

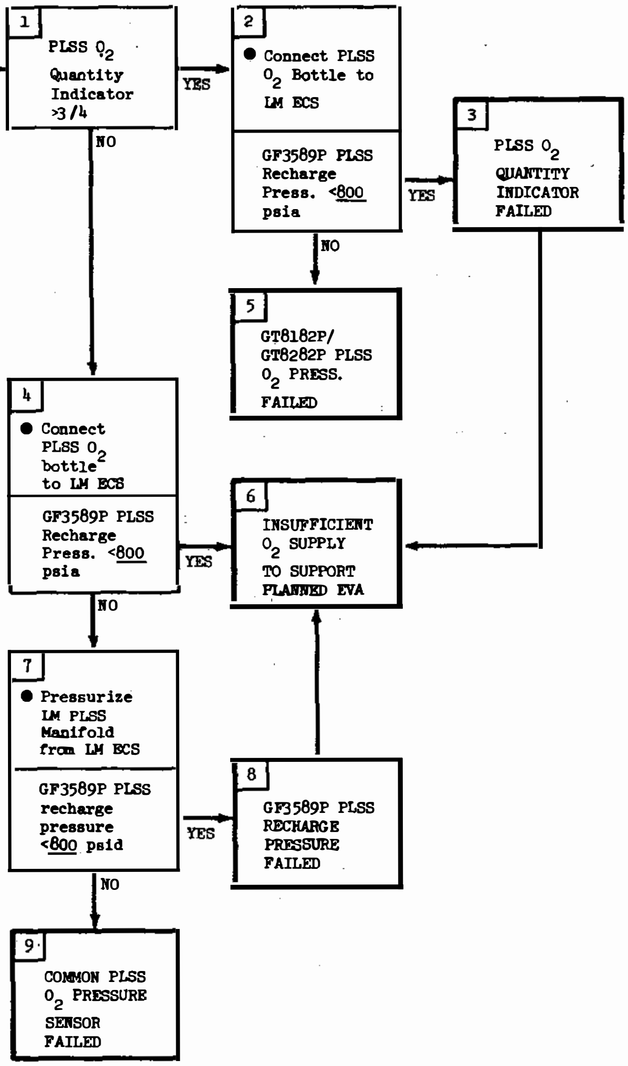
GT8182P/
GT8282P PLSS
O_2 pressure
<800 psia
(pre-EVA)

Possible causes:

a. GT8182P/
GT8282P
failed

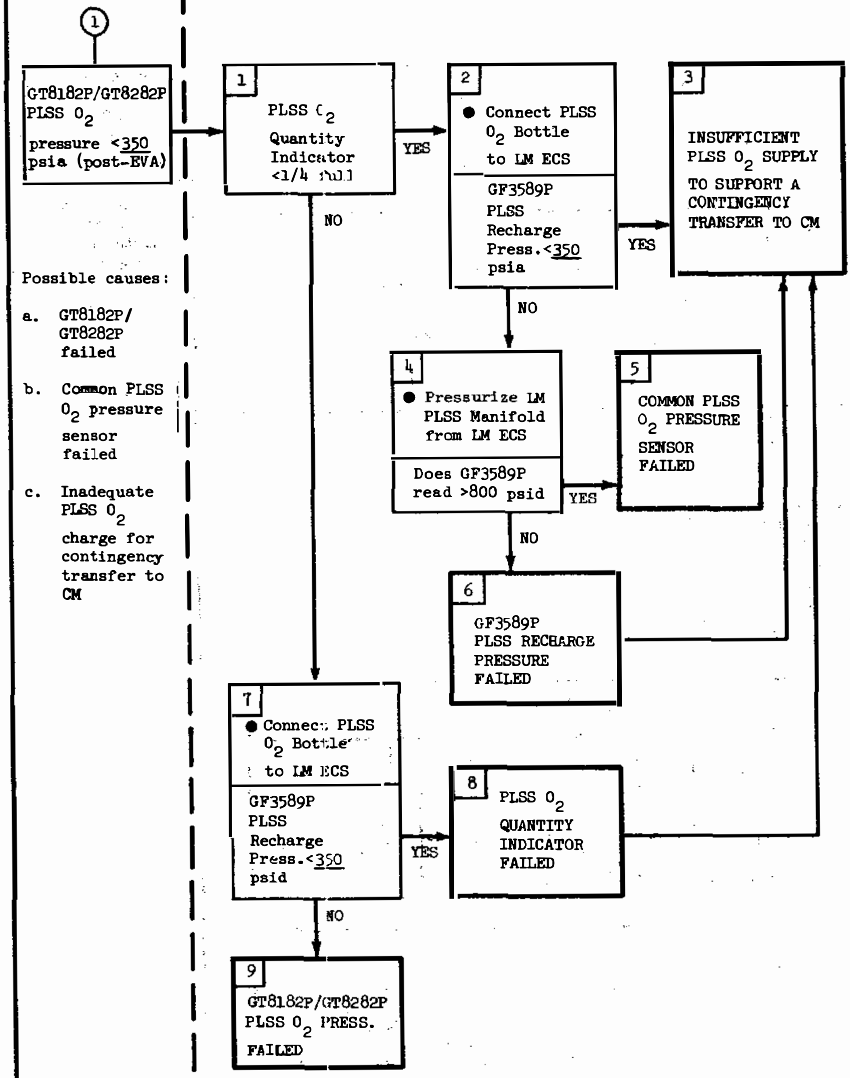
b. Inadequate
PLSS O_2
charge
for EVA

c. Common PLSS
O_2 pressure
sensor
failed


1
PLSS O_2 Quantity Indicator >3/4
YES
NO
2
● Connect PLSS O_2 Bottle to LM ECS
GF3589P PLSS Recharge Press. <800 psia
YES
NO
3
PLSS O_2 QUANTITY INDICATOR FAILED
5
GT8182P/ GT8282P PLSS O_2 PRESS. FAILED
4
● Connect PLSS O_2 bottle to LM ECS
GF3589P PLSS Recharge Press. <800 psia
YES
NO
6
INSUFFICIENT O_2 SUPPLY TO SUPPORT PLANNED EVA
7
● Pressurize LM PLSS Manifold from LM ECS
GF3589P PLSS recharge pressure <800 psid
YES
NO
8
GF3589P PLSS RECHARGE PRESSURE FAILED
9
COMMON PLSS O_2 PRESSURE SENSOR FAILED

① Provides enough O_2 for:
a) PLSS checkout
b) >3 hours normal operation at 1200 Btu/hr metabolic load, plus allowable EMU leakage.

SYMPTOM	PROCEDURE	REMARKS
EMU 24	POST EVA PROCEDURE	


①
GT8182P/GT8282P PLSS O_2 pressure <350 psia (post-EVA)
1 PLSS O_2 Quantity Indicator <1/4 full
YES
NO
2 ● Connect PLSS O_2 Bottle to LM ECS
GF3589P PLSS Recharge Press.<350 psia
YES
NO
3 INSUFFICIENT PLSS O_2 SUPPLY TO SUPPORT A CONTINGENCY TRANSFER TO CM
4 ● Pressurize LM PLSS Manifold from LM ECS
Does GF3589P read >800 psid
YES
NO
5 COMMON PLSS O_2 PRESSURE SENSOR FAILED
6 GF3589P PLSS RECHARGE PRESSURE FAILED
7 ● Connect PLSS O_2 Bottle to LM ECS
GF3589P PLSS Recharge Press.<350 psid
YES
NO
8 PLSS O_2 QUANTITY INDICATOR FAILED
9 GT8182P/GT8282P PLSS O_2 PRESS. FAILED

Possible causes:

a. GT8182P/GT8282P failed

b. Common PLSS O_2 pressure sensor failed

c. Inadequate PLSS O_2 charge for contingency transfer to CM

① Provides enough O_2 for:

a. PLSS checkout

b. 30-min contingency transfer at 2000 Btu/hr.

SYMPTOM	PROCEDURE	REMARKS

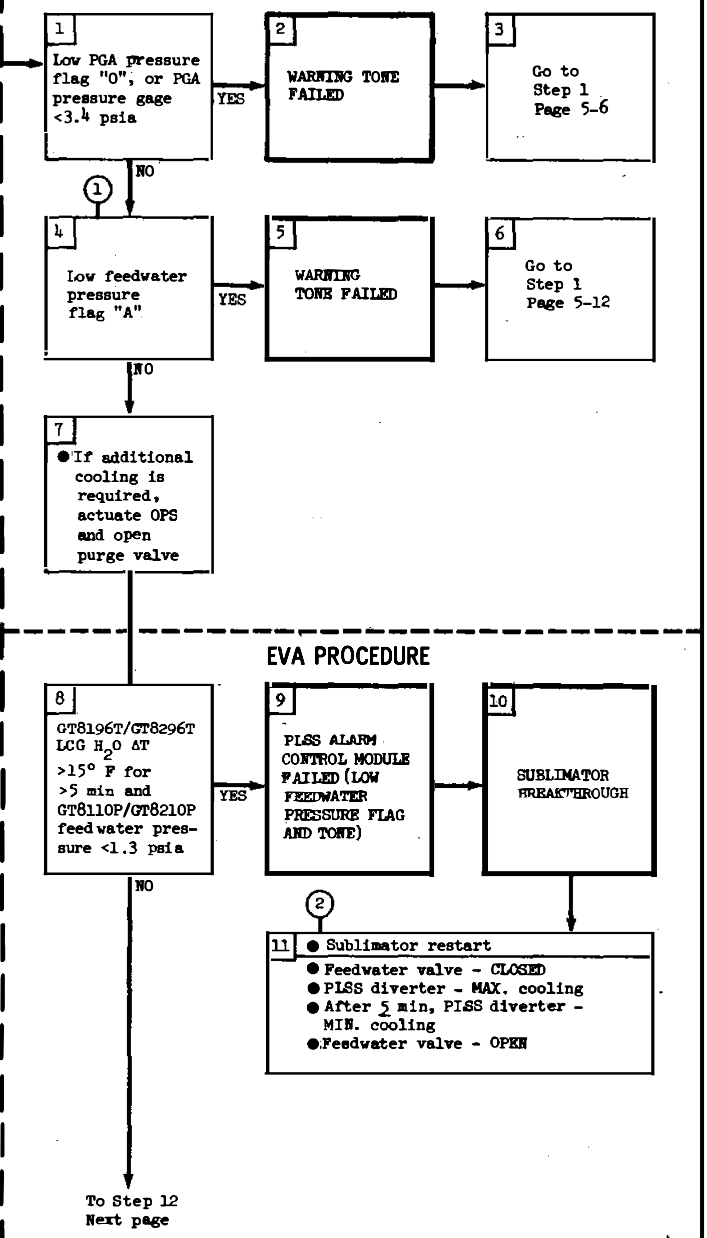
EMU 25

EMERGENCY PROCEDURE

GT8110P/GT8210P feedwater pressure <1.8 psid (no warning tone)

Possible causes:

- a. GT8110P/GT8210P failed
- b. Sublimator breakthrough
- c. H_2O separator blocked
- d. Depleted feedwater reservoir
- e. Blockage between feedwater bladder and pressure Xducer
- f. Feedwater pressure Xducer failed
- g. High feedwater usage rate
- h. Low PGA pressure
- i. Feedwater valve CLOSED


1
Low PGA pressure flag "O", or PGA pressure gage <3.4 psia
YES
2
WARNING TONE FAILED
3
Go to Step 1 Page 5-6
NO
①
4
Low feedwater pressure flag "A"
YES
5
WARNING TONE FAILED
6
Go to Step 1 Page 5-12
NO
7
● If additional cooling is required, actuate OPS and open purge valve
EVA PROCEDURE
8
GT8196T/GT8296T LCG H2O ΔT >15° F for >5 min and GT8110P/GT8210P feedwater pressure <1.3 psia
YES
9
PLSS ALARM CONTROL MODULE FAILED (LOW FEEDWATER PRESSURE FLAG AND TONE)
10
SUBLIMATOR BREAKTHROUGH
②
11
● Sublimator restart
● Feedwater valve - CLOSED
● PLSS diverter - MAX. cooling
● After 5 min, PLSS diverter - MIN. cooling
● Feedwater valve - OPEN
NO
To Step 12 Next page

① Low feedwater pressure warning actuates at 1.45 ± 0.15 psid.

② The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.

SYMPTOM | **PROCEDURE** | **REMARKS**

EMU 24

POST EVA PROCEDURE

①

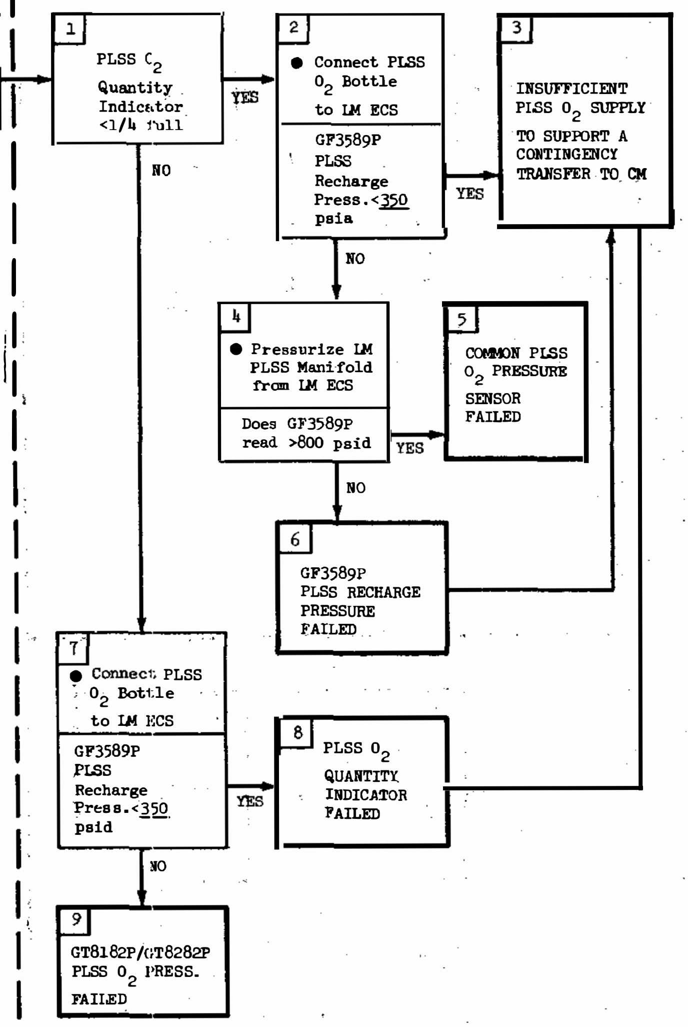
GT8182P/GT8282P PLSS O_2 pressure <350 psia (post-EVA)

Possible causes:

a. GT8182P/GT8282P failed

b. Common PLSS O_2 pressure sensor failed

c. Inadequate PLSS O_2 charge for contingency transfer to CM


1
PLSS O_2 Quantity Indicator <1/4 full
YES
NO
2
● Connect PLSS O_2 Bottle to LM ECS
GF3589P PLSS Recharge Press.<350 psia
YES
NO
3
INSUFFICIENT PLSS O_2 SUPPLY TO SUPPORT A CONTINGENCY TRANSFER TO CM
4
● Pressurize LM PLSS Manifold from LM ECS
Does GF3589P read >800 psid
YES
NO
5
COMMON PLSS O_2 PRESSURE SENSOR FAILED
6
GF3589P PLSS RECHARGE PRESSURE FAILED
7
● Connect PLSS O_2 Bottle to LM ECS
GF3589P PLSS Recharge Press.<350 psid
YES
NO
8
PLSS O_2 QUANTITY INDICATOR FAILED
9
GT8182P/GT8282P PLSS O_2 PRESS. FAILED

①

Provides enough O_2 for:

a. PLSS checkout

b. 30-min contingency transfer at 2000 Btu/hr.

SYMPTOM | **PROCEDURE** | **REMARKS**

EMU 25

GT8110P/GT8210P feedwater pressure <1.8 psid (no warning tone)

Possible causes:

a. GT8110P/GT8210P failed

b. Sublimator breakthrough

c. H_2O separator blocked

d. Depleted feedwater reservoir

e. Blockage between feedwater bladder and pressure Xducer

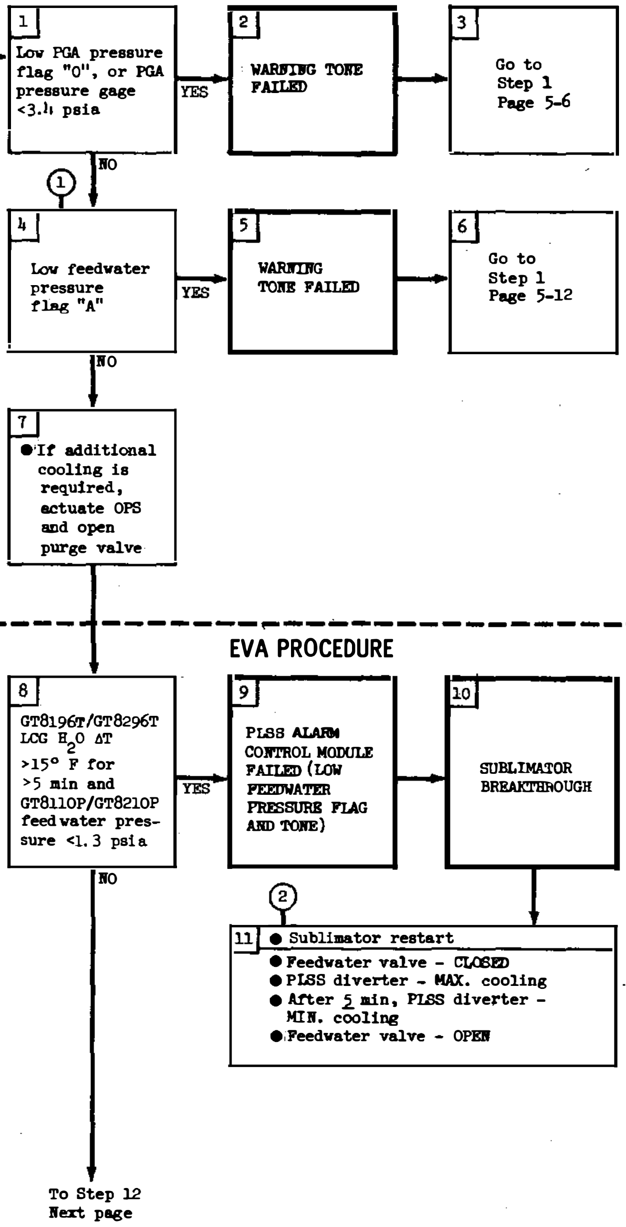
f. Feedwater pressure Xducer failed

g. High feedwater usage rate

h. Low PGA pressure

i. Feedwater valve CLOSED

EMERGENCY PROCEDURE

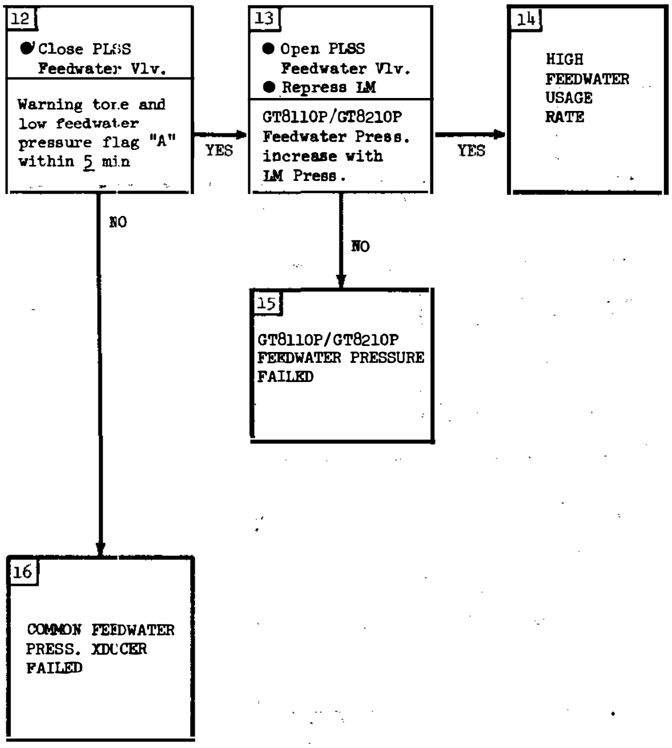

1
Low PGA pressure flag "0", or PGA pressure gage <3.4 psia
YES
2
WARNING TONE FAILED
3
Go to Step 1 Page 5-6
NO
①
4
Low feedwater pressure flag "A"
YES
5
WARNING TONE FAILED
6
Go to Step 1 Page 5-12
NO
7
● If additional cooling is required, actuate OPS and open purge valve
EVA PROCEDURE
8
GT8196T/GT8296T LCG H2O ΔT >15° F for >5 min and GT8110P/GT8210P feedwater pressure <1.3 psia
YES
9
PLSS ALARM CONTROL MODULE FAILED (LOW FEEDWATER PRESSURE FLAG AND TONE)
10
SUBLIMATOR BREAKTHROUGH
②
11
● Sublimator restart
● Feedwater valve - CLOSED
● PLSS diverter - MAX. cooling
● After 5 min, PLSS diverter - MIN. cooling
● Feedwater valve - OPEN
NO
To Step 12 Next page

① Low feedwater pressure warning actuates at 1.45 ± 0.15 psid.

② The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE


12
● Close PLSS Feedwater Vlv.
Warning tone and low feedwater pressure flag "A" within 5 min
YES
NO
13
● Open PLSS Feedwater Vlv.
● Repress LM
GT8110P/GT8210P Feedwater Press. increase with LM Press.
YES
NO
14
HIGH FEEDWATER USAGE RATE
15
GT8110P/GT8210P FEEDWATER PRESSURE FAILED
16
COMMON FEEDWATER PRESS. XDUCER FAILED

SYMPTOM	PROCEDURE	REMARKS

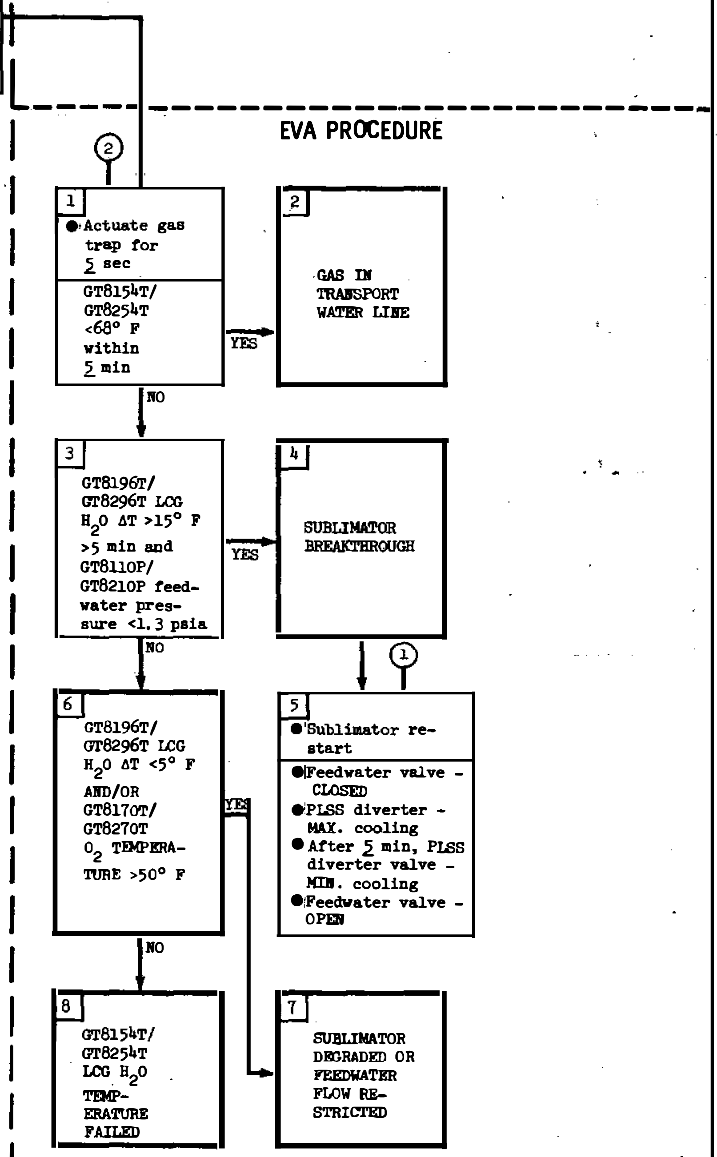
EMU 26

GT815T/
GT8154T
GT8254T LCG
H_2O temperature
>68° F with
diverter valve
in MAX. cooling

Possible causes:

- a. GT8154T/ GT8254T failed
- b. Sublimator degraded
- c. Feedwater flow restricted
- d. Sublimator breakthrough

EMERGENCY PROCEDURE


EVA PROCEDURE
②
1
● Actuate gas trap for 5 sec
GT8154T/ GT8254T <68° F within 5 min
YES
2
GAS IN TRANSPORT WATER LINE
NO
3
GT8196T/ GT8296T LCG H_2O ΔT >15° F >5 min and GT8110P/ GT8210P feedwater pressure <1.3 psia
YES
4
SUBLIMATOR BREAKTHROUGH
①
5
● Sublimator restart
● Feedwater valve - CLOSED
● PLSS diverter - MAX. cooling
● After 5 min, PLSS diverter valve - MIN. cooling
● Feedwater valve - OPEN
NO
6
GT8196T/ GT8296T LCG H_2O ΔT <5° F AND/OR GT8170T/ GT8270T O_2 TEMPERATURE >50° F
YES
NO
8
GT8154T/ GT8254T LCG H_2O TEMPERATURE FAILED
7
SUBLIMATOR DEGRADED OR FEEDWATER FLOW RESTRICTED

① The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.

② Actuation of the gas trap must be performed by another EV crewman. It cannot be self-accomplished.

SYMPTOM	PROCEDURE	REMARKS

EMU 27

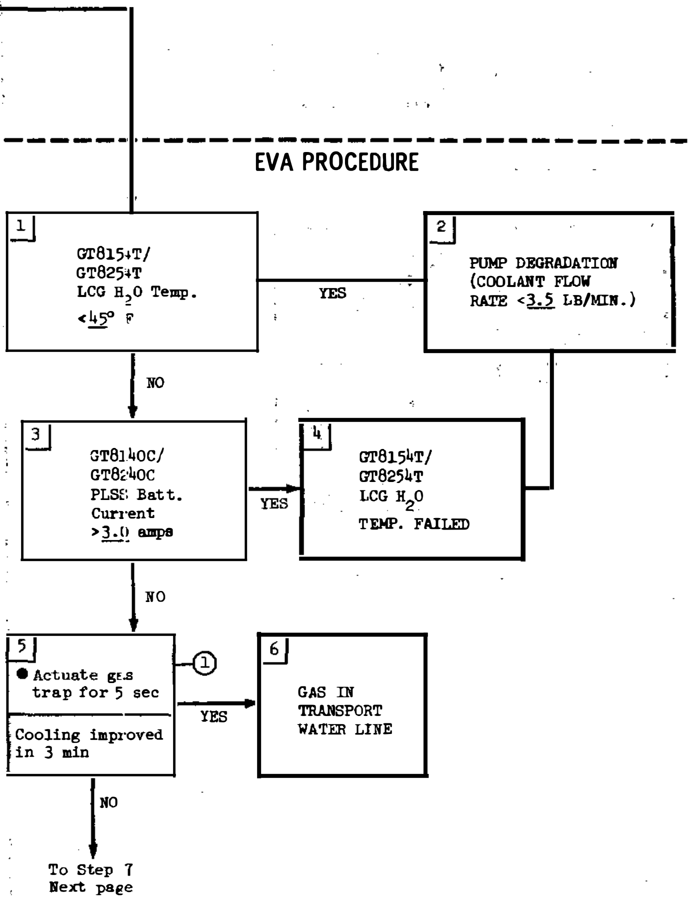
EMERGENCY PROCEDURE

GT8196T/GT8296T LCG H_2O ΔT >11° F (MAX. diverter valve position)

Possible causes:

- a. GT8196T/GT8296T failed
- b. Pump degradation
- c. Gas in transport water line
- d. Sublimator breakthrough

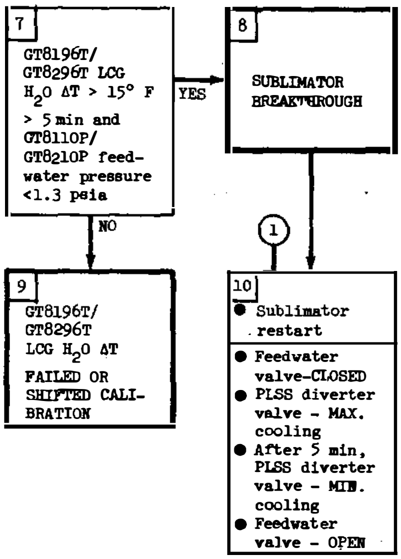
EVA PROCEDURE


1
GT8154T/ GT8254T LCG H2O Temp. <45° F
YES
2
PUMP DEGRADATION (COOLANT FLOW RATE <3.5 LB/MIN.)
NO
3
GT8140C/ GT8240C PLSS Batt. Current >3.0 amps
YES
4
GT8154T/ GT8254T LCG H2O TEMP. FAILED
NO
5
● Actuate gas trap for 5 sec
Cooling improved in 3 min
①
YES
6
GAS IN TRANSPORT WATER LINE
NO
To Step 7 Next page

① During EV operations, actuation of the gas trap can be performed by an assisting crewman only.

SYMPTOM | PROCEDURE | REMARKS

EVA PROCEDURE (continued)


7
GT8196T/ GT8296T LCG H_2O ΔT > 15° F > 5 min and GT8110P/ GT8210P feed-water pressure <1.3 psia
YES
NO
8
SUBLIMATOR BREAKTHROUGH
①
9
GT8196T/ GT8296T LCG H_2O ΔT FAILED OR SHIFTED CALIBRATION
10
● Sublimator restart
● Feedwater valve-CLOSED
● PLSS diverter valve - MAX. cooling
● After 5 min, PLSS diverter valve - MIN. cooling
● Feedwater valve - OPEN

①
The heat load should be maintained during the first 5 min since the objective is to dry-out the sublimator.

SYMPTOM | PROCEDURE | REMARKS

EMU 28

EMERGENCY PROCEDURE

①

GT8140C/GT8240C PLSS battery current >3.0 amps

2.4 to 2.6 is normal operating current

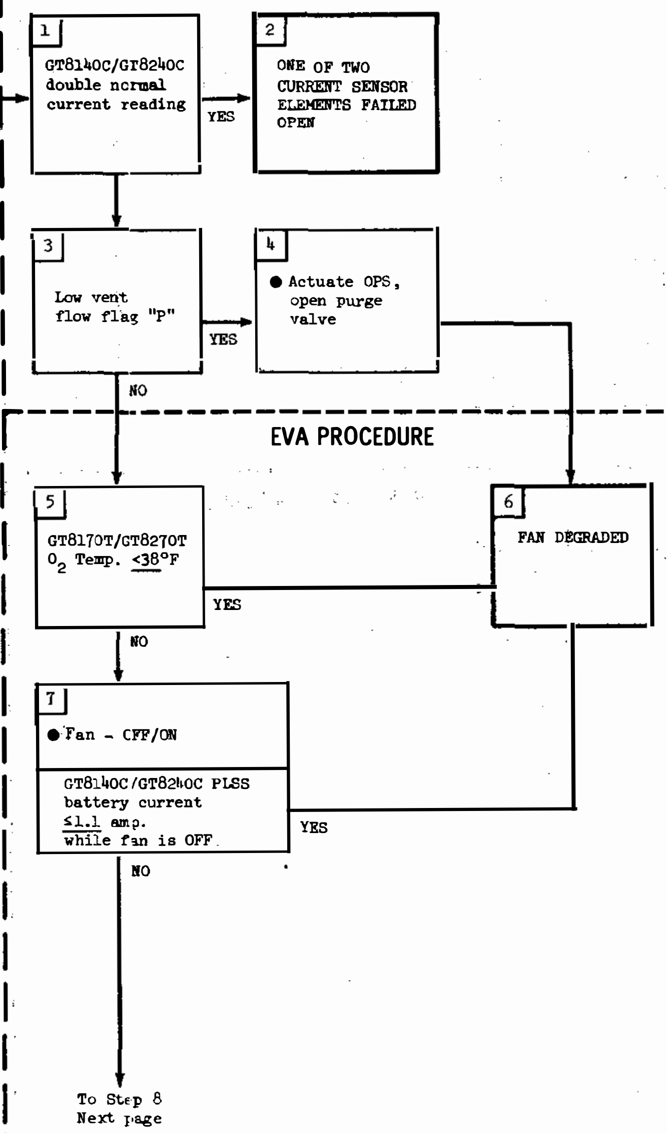
Possible causes:

a. GT8140C/ GT8240C failed

b. Fan degraded

c. Current sensor failed

d. Pump degraded


1
GT8140C/GT8240C double normal current reading
YES
2
ONE OF TWO CURRENT SENSOR ELEMENTS FAILED OPEN
3
Low vent flow flag "P"
YES
4
● Actuate OPS, open purge valve
NO
EVA PROCEDURE
5
GT8170T/GT8270T O_2 Temp. <38°F
YES
6
FAN DEGRADED
NO
7
● Fan - OFF/ON
GT8140C/GT8240C PLSS battery current ≤1.1 amp. while fan is OFF
YES
NO
To Step 8 Next page

①

Nominal PLSS power loads with EVCS operating in the primary mode:

a. EVCS - 0.6 amp

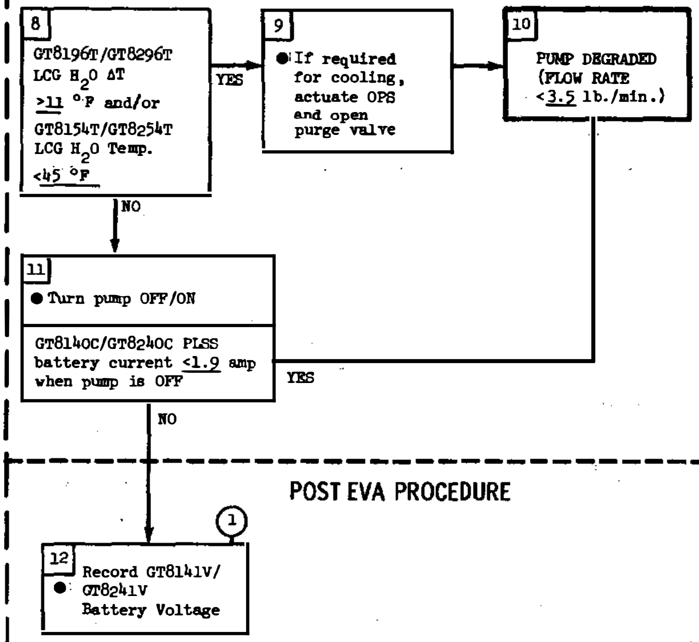
b. Fan - 1.3 amp

c. Pump - 0.5 amp

Total 2.4 amp

SYMPTOM | **PROCEDURE** | **REMARKS**

EVA PROCEDURE (continued)


8
GT8196T/GT8296T LCG H_2O ΔT ≥11 °F and/or GT8154T/GT8254T LCG H_2O Temp. <45 °F
YES
9
● If required for cooling, actuate OPS and open purge valve
10
PUMP DEGRADED (FLOW RATE <3.5 lb./min.)
NO
11
● Turn pump OFF/ON
GT8140C/GT8240C PLSS battery current ≤1.9 amp when pump is OFF
YES
NO
POST EVA PROCEDURE
①
12
● Record GT8141V/GT8241V Battery Voltage

① Normal PLSS battery voltage = 16.8 ± 0.8 Vdc and GT8141V/GT8241V inaccuracy is ±0.19 Vdc.

SYMPTOM	PROCEDURE	REMARKS
EMU 29	**EMERGENCY PROCEDURE**	

GT8140C/GT8240C PLSS battery current < 2.3 amp (no warning tone)

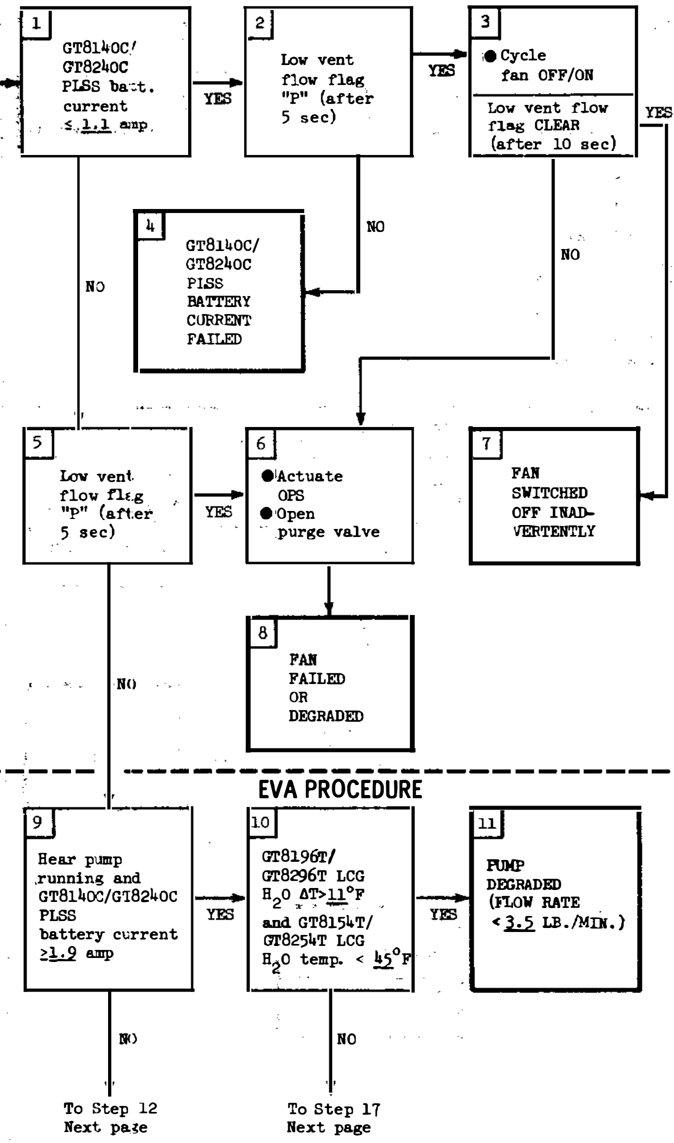
2.4 to 2.6 is normal operating current

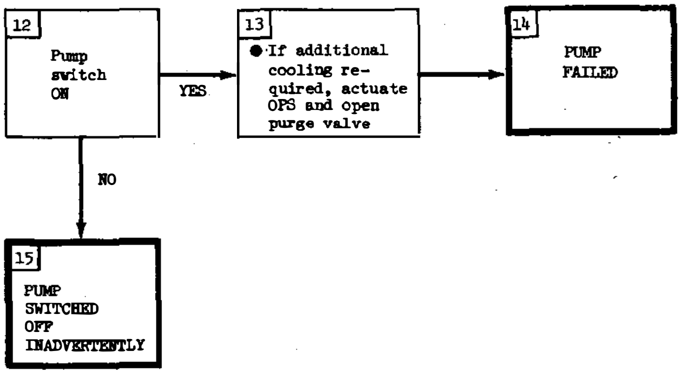
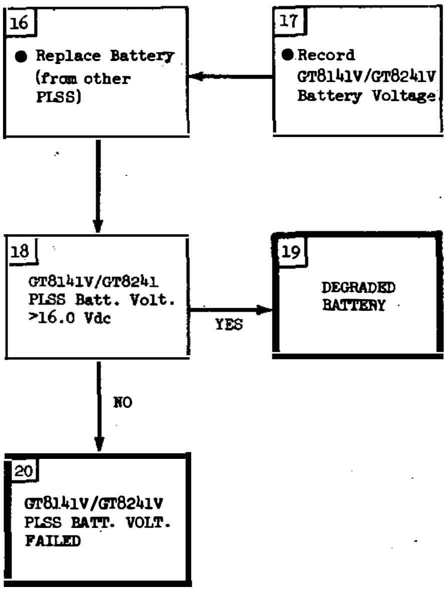
Possible causes:

a. GT8140C/GT8240C failed

b. Fan OFF, failed, or degraded

c. Pump OFF, failed, or degraded



SYMPTOM	PROCEDURE	REMARKS
	EVA PROCEDURE (continued)  12 Pump switch ON YES NO 13 ● If additional cooling required, actuate OPS and open purge valve 14 PUMP FAILED 15 PUMP SWITCHED OFF INADVERTENTLY POST EVA PROCEDURE  16 ● Replace Battery (from other PLSS) 17 ● Record GT8141V/GT8241V Battery Voltage 18 GT8141V/GT8241 PLSS Batt. Volt. >16.0 Vdc YES NO 19 DEGRADED BATTERY 20 GT8141V/GT8241V PLSS BATT. VOLT. FAILED	

SYMPTOM	PROCEDURE	REMARKS

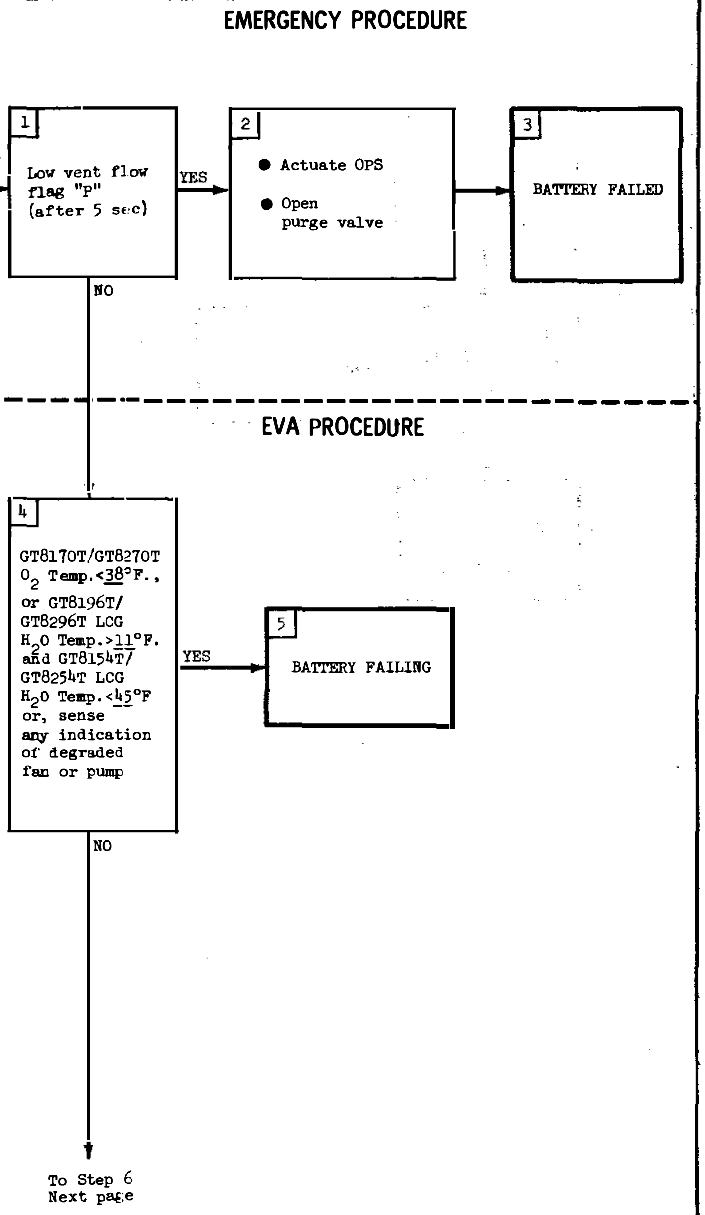
EMU 30

GT8141V/
GT8241V
PLSS battery voltage ≤16.0 Vdc (no warning tone)

Possible causes:

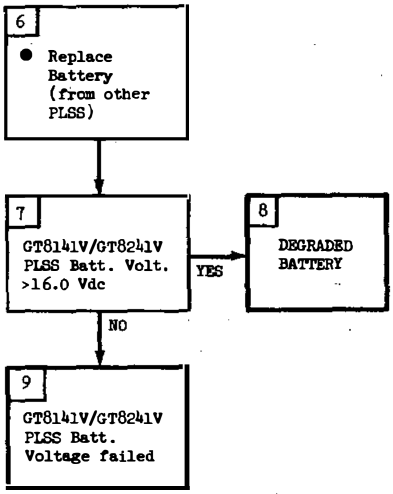
a. GT8141V/ GT8241V failed

b. Battery failed or degraded


EMERGENCY PROCEDURE
1
Low vent flow flag "P" (after 5 sec)
YES
NO
2
● Actuate OPS
● Open purge valve
3
BATTERY FAILED
EVA PROCEDURE
4
GT8170T/GT8270T O2 Temp.<38°F., or GT8196T/ GT8296T LCG H2O Temp.>11°F. and GT8154T/ GT8254T LCG H2O Temp.<45°F or, sense any indication of degraded fan or pump
YES
5
BATTERY FAILING
NO
To Step 6 Next page

SYMPTOM	PROCEDURE	REMARKS

POST EVA PROCEDURE


6
● Replace Battery (from other PLSS)
7
GT8141V/GT8241V PLSS Batt. Volt. >16.0 Vdc
YES
8
DEGRADED BATTERY
NO
9
GT8141V/GT8241V PLSS Batt. Voltage failed

SYMPTOM	PROCEDURE	REMARKS

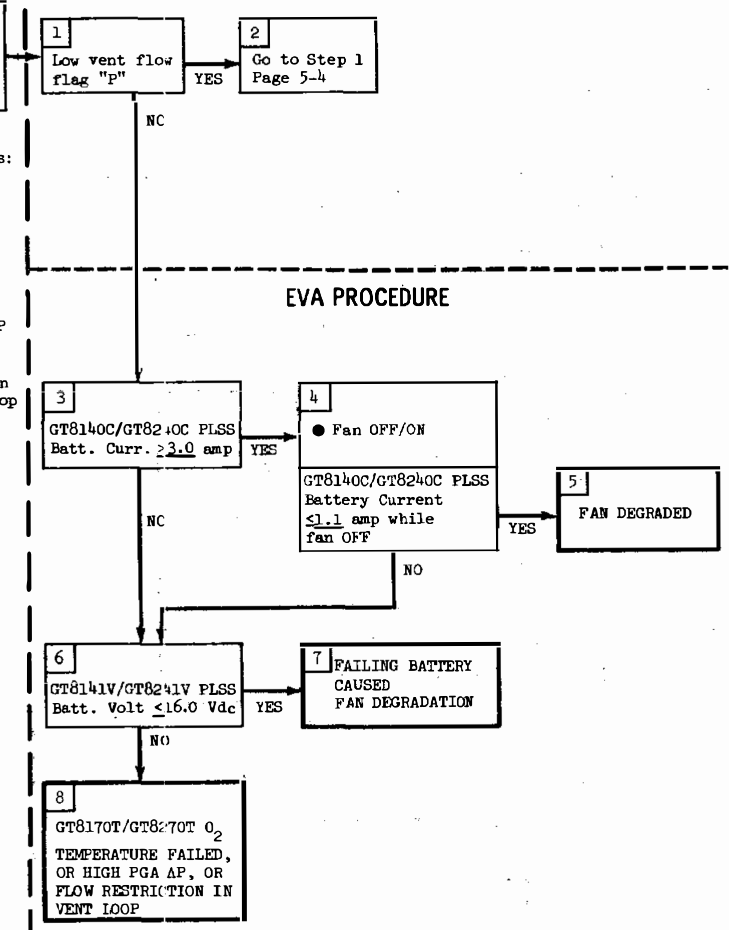
EMU 31

GT8170T/ GT8270T O_2 temperature $\leq 38°$ F (no warning tone)

Possible causes:

- a. GT8170T/ GT8270T failed
- b. Fan OFF or degraded
- c. High PGA ΔP
- d. Flow restriction in vent loop

EMERGENCY PROCEDURE


1
Low vent flow flag "P"
YES
2
Go to Step 1 Page 5-4
NO
EVA PROCEDURE
3
GT8140C/GT8240C PLSS Batt. Curr. ≥3.0 amp
YES
4
● Fan OFF/ON
GT8140C/GT8240C PLSS Battery Current ≤1.1 amp while fan OFF
YES
5
FAN DEGRADED
NO
NO
6
GT8141V/GT8241V PLSS Batt. Volt ≤16.0 Vdc
YES
7
FAILING BATTERY CAUSED FAN DEGRADATION
NO
8
GT8170T/GT8270T O2 TEMPERATURE FAILED, OR HIGH PGA ΔP, OR FLOW RESTRICTION IN VENT LOOP

SYMPTOM	PROCEDURE	REMARKS

EMU 32

EMERGENCY PROCEDURE

GT8170T/GT8270T O_2 temperature >52° F (no warning tone)

Possible causes:

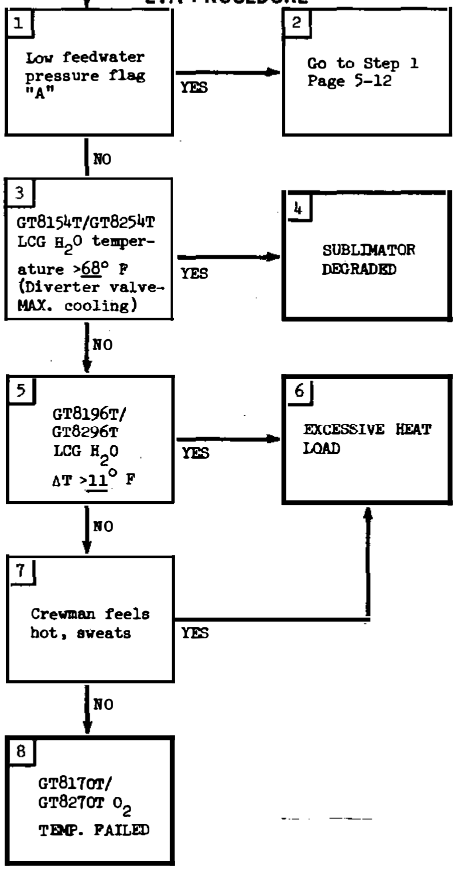
a. GT8170T/GT8270T failed

b. Sublimator breakthrough or degradation

c. Feedwater depleted

d. Blocked water separator

EVA PROCEDURE


1
Low feedwater pressure flag "A"
YES
2
Go to Step 1 Page 5-12
NO
3
GT8154T/GT8254T LCG H_2O temperature >68° F (Diverter valve-MAX. cooling)
YES
4
SUBLIMATOR DEGRADED
NO
5
GT8196T/GT8296T LCG H_2O ΔT >11° F
YES
6
EXCESSIVE HEAT LOAD
NO
7
Crewman feels hot, sweats
YES
NO
8
GT8170T/GT8270T O_2 TEMP. FAILED